Wolfram *Mathematica*®

Il software di riferimento per la Didattica, la Ricerca e lo Sviluppo

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Lezione 3

Gestione dati con *Mathematica* : Import / Export

Crescenzio Gallo – Università di Foggia

crescenzio.gallo@unifg.it

Note:

- Il materiale visualizzato durante questo seminario è disponibile per il download all'indirizzo http://www.crescenziogallo.it/unifg/seminario-mathematica-2014/
- Il materiale utilizzato è tratto dai webinar pubblicati da Adalta e prodotti dal dott. Roberto Cavaliere (*Mathematica* Technical Sales Manager, *r.cavaliere@adalta.it*)

Agenda

Introduzione

- *Mathematica* è un linguaggio di sviluppo
- Differenti modi di eseguire *Mathematica*

Integrazione/interazione con altri ambienti

- Possibili link
- Import/Export di dati

Conclusioni

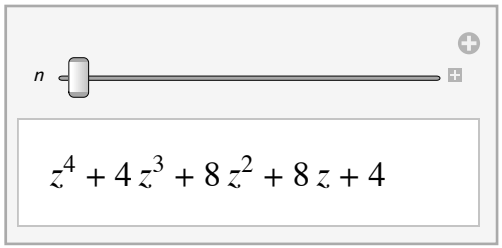
Introduzione: *Mathematica* è un linguaggio di sviluppo

Poichè siamo abituati ad usare *Mathematica* attraverso il front end capita spesso di pensare di non considerare la vera natura *Mathematica* ossia quella di linguaggio di programmazione.
Già nel fare un semplice calcolo e renderlo parametrico e farlo computare al variare del parametro in effetti abbiamo sfruttato capacità di programmazione del linguaggio *Mathematica*.

```
Expand[((z + 1)^2 + 1)^2]
```

$$z^4 + 4\,z^3 + 8\,z^2 + 8\,z + 4$$

```
Manipulate[Expand[((z + 1)^2 + 1)^n], {n, 2, 10, 1}]
```



Nonostante *Mathematica* sia un linguaggio funzionale, di fatto mette a disposizione set di funzioni dedicati ai vari approcci programmazione:

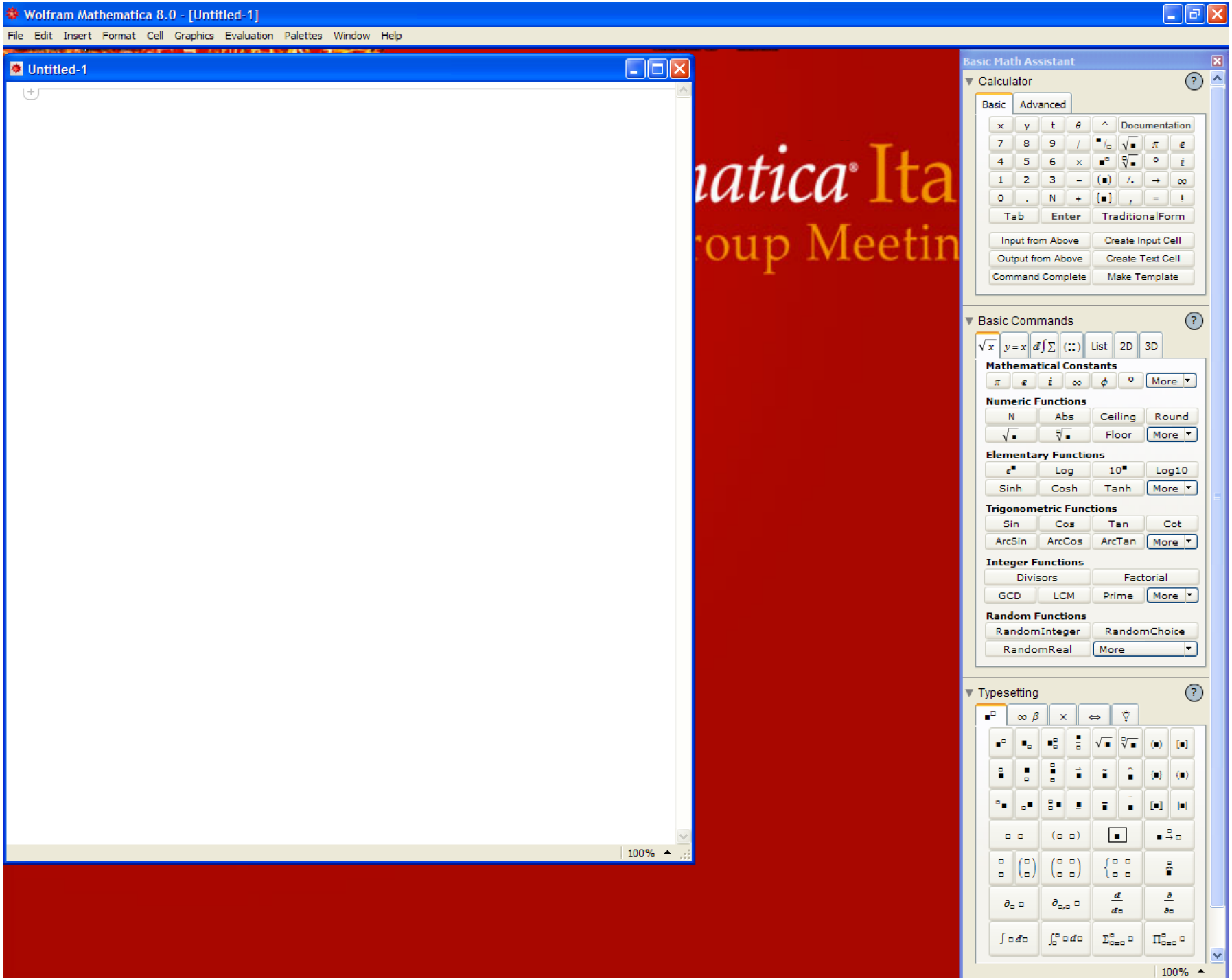
Functional Programming
Procedural Programming
Rule-Based Programming
Graph Programming
CUDA Programming

Dunque un'altra delle sua caratteristiche è che si presenta come un linguaggio **pluriparadigmatico**.

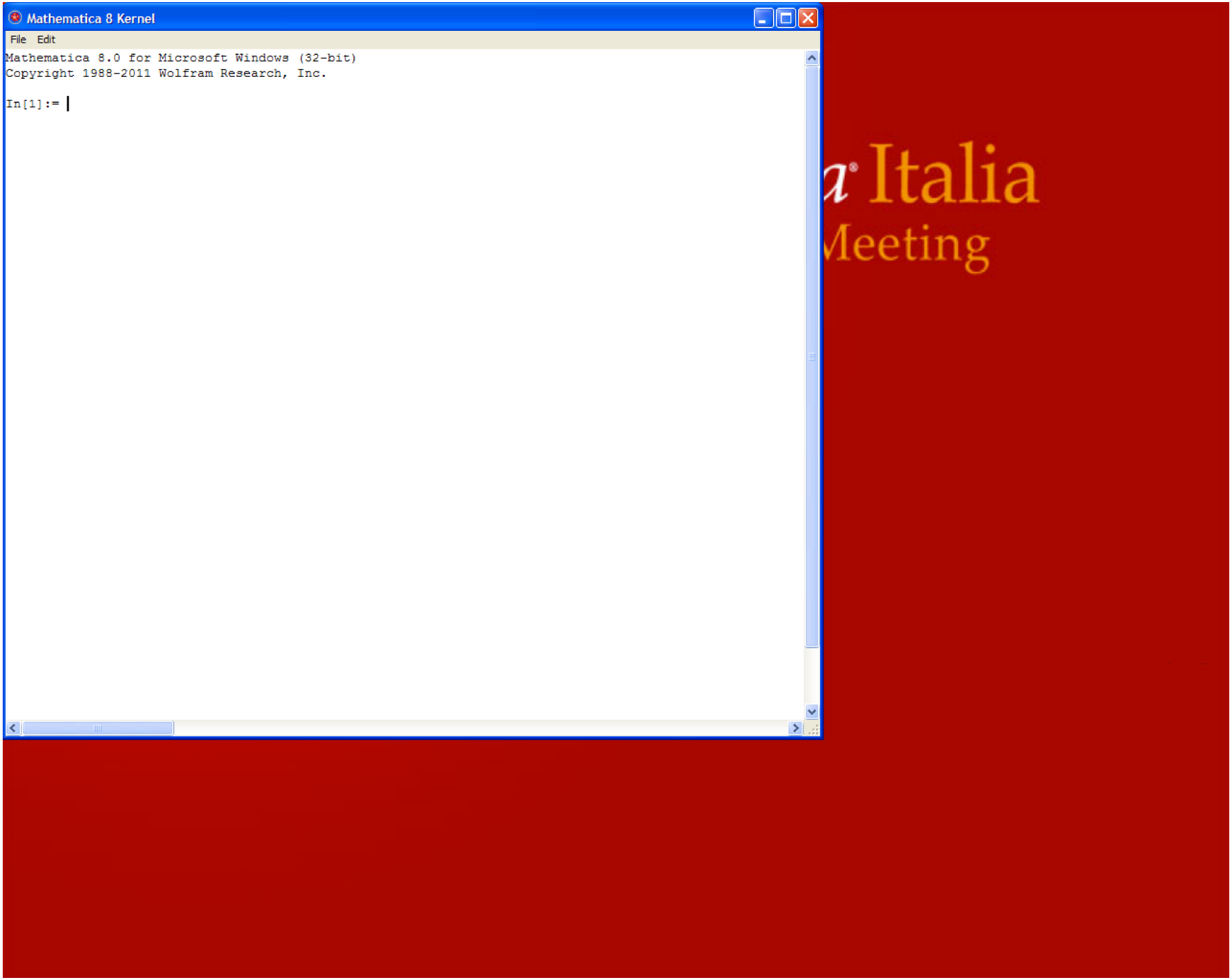
Introduzione: differenti modi di eseguire *Mathematica*

L'architettura interna di *Mathematica* consiste di due moduli separati:

L'interfaccia utente o **front end**: il modulo dedicato al dialogo con l'utente (interpretazioni delle linee di input e rappresentazione degli output).


Wolfram Mathematica 8.0 - [Untitled-1]
File Edit Insert Format Cell Graphics Evaluation Palettes Window Help
Untitled-1
100%
Basic Math Assistant
Calculator
Basic
Advanced
Documentation
Tab
Enter
TraditionalForm
Input from Above
Create Input Cell
Output from Above
Create Text Cell
Command Complete
Make Template
Basic Commands
List
2D
3D
Mathematical Constants
More
Numeric Functions
N
Abs
Ceiling
Round
Floor
Elementary Functions
Log
Log10
Sinh
Cosh
Tanh
Trigonometric Functions
Sin
Cos
Tan
Cot
ArcSin
ArcCos
ArcTan
Integer Functions
Divisors
Factorial
GCD
LCM
Prime
Random Functions
RandomInteger
RandomChoice
RandomReal
Typesetting
100%

Il motore di calcolo o **kernel**, dedicato alle computazioni vere e proprie


Mathematica 8 Kernel
File Edit
Mathematica 8.0 for Microsoft Windows (32-bit)
Copyright 1988-2011 Wolfram Research, Inc.
In[1]:=
Italia
Meeting

I due moduli sono in collegamento attraverso il *MathLink*, una libreria in grado di far dialogare il kernel con diversi altri sistem
Questa architettura consente l'impiego di *Mathematica* in moltissimi contesti differenti e secondo moltissime modalità.
Ad esempio si può usare il semplice kernel se bisogna fare solo calcoli e non si necessità di controllare "visivamente" l'esecuzion
dei calcoli stessi.

Integrazione/interazione con altri ambienti: possibili link

L'architettura sopra descritta, ossia la separazione tra il front end ed il kernel ha consentito lo sviluppo di numerose altre inter facce per il kernel di *Mathematica*. Infatti il kernel si può integrare con linguaggio come il C C++, Fortran, Java, .NET ed alt (Systems Interfaces & Deployment).

Vediamo un'applicazione che utilizza Java per l'interfaccia utente ed il kernel di *Mathematica* per i calcoli: `EquationTrekker`

Integrazione/interazione con altri ambienti: Import/Export di dati

Mathematica consente di importare dati in diversi modi.

- Formati standard riconosciuti in import (circa 170 formati)
- Accesso ai database (MySQL, Oracle, ...)
- Dati curati (FinancialData, WeatherData, CountryData, ...)

Integrazione/interazione con altri ambienti: Import/Export di dati

Alcune novità in *Mathematica* 8:

- Geospatial Formats

  ArcGRID, GPX, GRIB, KML/KMZ, NDK, SurferGrid, TLE

- Graph Formats

  DIMACS, DOT, Graphlet, GraphML, GXL, LEDA, Pajek, TGF

- Bioscience and chemistry formats

  Affymetrix, BDF, CIF, EDF, NEXUS

- Multimedia and graphics formats

  FLAC, MKV, QuickTime (export), VideoFrames

- Miscellaneous formats »

  C, ICS, JSON, NASACDF, VTK, XLSX

$ImportFormats

{3DS, ACO, Affymetrix, AgilentMicroarray, AIFF, ApacheLog, ArcGRID, AU, AVI, Base64, BDF, Binary, Bit, BMP, Byte, BYU, BZIP2, CDED, CDF, Character16, Character8, CIF, Complex128, Complex256, Complex64, CSV, CUR, DBF, DICOM, DIF, DIMACS, Directory, DOT, DXF, EDF, EPS, ExpressionML, FASTA, FASTQ, FCS, FITS, FLAC, GenBank, GeoTIFF, GIF, GPX, Graph6, Graphlet, GraphML, GRIB, GTOPO30, GXL, GZIP, HarwellBoeing, HDF, HDF5, HIN, HTML, ICC, ICNS, ICO, ICS, Integer128, Integer16, Integer24, Integer32, Integer64, Integer8, JCAMP-DX, JPEG, JPEG2000, JSON, JVX, KML, LaTeX, LEDA, List, LWO, MAT, MathML, MBOX, MDB, MGF, MIDI, MMCIF, MOL, MOL2, MPS, MTP, MTX, MX, NASACDF, NB, NDK, NetCDF, NEXUS, NOFF, OBJ, ODS, OFF, OpenEXR, Package, Pajek, PBM, PCX, PDB, PDF, PGM, PLY, PNG, PNM, PPM, PXR, QuickTime, RawBitmap, Real128, Real32, Real64, RIB, RSS, RTF, SCT, SDF, SDTS, SDTSDEM, SFF, SHP, SMILES, SND, SP3, Sparse6, STL, String, SurferGrid, SXC, Table, TAR, TerminatedString, Text, TGA, TGF, TIFF, TIGER, TLE, TSV, UnsignedInteger128, UnsignedInteger16, UnsignedInteger24, UnsignedInteger32, UnsignedInteger64, UnsignedInteger8, USGSDEM, UUE, VCF, VCS, VTK, WAV, Wave64, WDX, XBM, XHTML, XHTMLMathML, XLS, XLSX, XML, XPORT, XYZ, ZIP}

$ExportFormats

{3DS, ACO, AIFF, AU, AVI, Base64, Binary, Bit, BMP, Byte, BYU, BZIP2, C, CDF, Character16, Character8, Complex128, Complex256 Complex64, CSV, CUR, DICOM, DIF, DIMACS, DOT, DXF, EMF, EPS, ExpressionML, FASTA, FASTQ, FCS, FITS, FLAC, FLV, GIF, Graph6, Graphlet, GraphML, GXL, GZIP, HarwellBoeing, HDF, HDF5, HTML, ICNS, ICO, Integer128, Integer16, Integer24, Integer32, Integer64, Integer8, JPEG, JPEG2000, JSON, JVX, KML, LEDA, List, LWO, MAT, MathML, Maya, MGF, MIDI, MOL, MOL2, MTX, MX, NASACDF, NB, NetCDF, NEXUS, NOFF, OBJ, OFF, Package, Pajek, PBM, PCX, PDB, PDF, PGM, PICT, PLY, PNG, PNM, POV, PPM, PXR, QuickTime, RawBitmap, Real128, Real32, Real64, RIB, RTF, SCT, SDF, SND, Sparse6, STL, String, SurferGrid, SVG, SWF, Table, TAR, TerminatedString, TeX, Text, TGA, TGF, TIFF, TSV, UnsignedInteger128, UnsignedInteger16, UnsignedInteger24, UnsignedInteger32, UnsignedInteger64, UnsignedInteger8, UUE, VideoFrames, VRML, VTK, WAV, Wave64, WDX, X3D, XBM, XHTML, XHTMLMathML, XLS, XLSX, XML, XYZ, ZIP, ZPR}

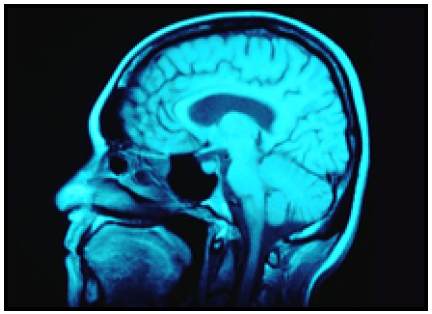
Integrazione/interazione con altri ambienti: Import/Export di dati

Sintassi di base della Import

- `Import["`*file*`",`*format*`]`: importa dati dal file specificato restituendono la versione Mathematica
- `Import["`*file*`", {`*format*`,` *elements*`}]`: importa dal file solo gli elementi specificati.
- `Import["http://`*url*`",…]`: importa da un qualsiasi URL accessibile (anche se sono richieste credenziali di accesso)

La maggior parte dei casi si può omettere il formato del file e la Import sarà comunque in grado di identificare il formato automat camente dal file stesso

```
Import["ExampleData/mri.pxr"]
```



```
Import["ExampleData/cities.xls"]
```

{{City, Country, Population} {Tokyo, Japan, 8.3×10^6} {Chicago, United States, 2.8×10^6} {London, United Kingdom, 7.4×10^6} {Berlin

Se un determinato formato di dati è incluso nella lista **$ImportFormats** significa che *Mathematica* è in grado di gestire anch tutti i metadati associati a tale formato

```
Import["ExampleData/cities.xls", "Elements"]
```

{Data, FormattedData, Formulas, Images, Sheets}

```
Import[ "http://exampledata.wolfram.com/ArcGRID.zip", {"ArcGRID", "Elements"}]
```

{Centering, CentralScaleFactor, CoordinateSystem, CoordinateSystemInformation, Data, DataFormat, Datum, ElevationRange, Graphics, GridOrigin, Image, InverseFlattening, LinearUnits, Projection, ProjectionName, RasterSize, ReferenceModel, ReliefImage, SemimajorAxis, SemiminorAxis, SpatialRange, SpatialResolution, StandardParallels}

Questo esempio crea una tabella con tutti i metadati contenuti in un file DICOM utilizzato dalle apparecchiature di diagnostica pe immagini

```
Grid[List @@@ Import["ExampleData/head.dcm.gz", "MetaInformation"], Alignment → {Left, Baseline},
 Frame → All, Background → {{White, None}, {{LightGray, LightBlue}}}]
```

MetaElementGroupLength	208
FileMetaInformationVersion	{0, 1}
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MediaStorageSOPInstanceUID	{1, 3, 46, 670 589, 11, 0, 0, 11, 4, 2, 0, 10 453, 5, 4100, 2 005 032 223 165 618 714}
TransferSyntaxUID	{1, 2, 840, 10 008, 1, 2, 1}
ImplementationClassUID	{1, 2, 840, 113 654, 2, 3, 1995, 2, 12, 0}
ImplementationVersionName	MIRCTN16NOV2000
SpecificCharacterSet	ISO_IR 100
ImageType	{ORIGINAL, PRIMARY, M_FFE, M, FFE}
InstanceCreationDate	{2005, 3, 22}
InstanceCreationTime	{23, 17, 0}
InstanceCreatorUID	{1, 3, 46, 670 589, 11, 10 453, 5}
SOPClassUID	{1, 2, 840, 10 008, 5, 1, 4, 1, 1, 4}
SOPInstanceUID	{1, 3, 46, 670 589, 11, 0, 0, 11, 4, 2, 0, 10 453, 5, 4100, 2 005 032 223 165 618 714}
StudyDate	{2005, 3, 22}
SeriesDate	{2005, 3, 22}
AcquisitionDate	{2005, 3, 22}
ContentDate	{2005, 3, 22}
StudyTime	{22, 8, 40}
SeriesTime	{22, 13, 34.6}
AcquisitionTime	{22, 13, 34.6}
ContentTime	{22, 13, 34.6}
AccessionNumber	2200000000
Modality	MR
Manufacturer	Philips Medical Systems

InstitutionName	Praxisgemeinschaft Aachen
StationName	PMSN−HYDWC6QW68
StudyDescription	TEST
SeriesDescription	HIRN T1/3D/FFE**
ManufacturerModel	Intera
ReferencedStudyComponentSequence	{SpecificCharacterSet → ISO_IR 100, InstanceCreationDate → {2005, 3, 22}, InstanceCreationTime → {23, 17, 2}, InstanceCreatorUID → {1, 3, 46, 670 589, 11, 10 453, 5}, ReferencedSOPClassUID → {1, 2, 840, 10 008, 3, 1, 2, 3, 3}, ReferencedSOPInstanceUID → {1, 3, 46, 670 589, 11, 0, 0, 11, 4, 2, 0, 10 453, 5, 3320, 2 005 032 222 082 071 829}, InstanceNumber → 0}
ReferencedImageSequence	{{ReferencedSOPClassUID → {1, 2, 840, 10 008, 5, 1, 4, 1, 1, 4}, ReferencedSOPInstanceUID → {1, 3, 46, 670 589, 11, 0, 0, 11, 4, 2, 0, 10 453, 5, 4100, 2 005 032 222 092 884 501}}, {ReferencedSOPClassUID → {1, 2, 840, 10 008, 5, 1, 4, 1, 1, 4}, ReferencedSOPInstanceUID → {1, 3, 46, 670 589, 11, 0, 0, 11, 4, 2, 0, 10 453, 5, 4100, 2 005 032 222 092 867 498}}, {ReferencedSOPClassUID → {1, 2, 840, 10 008, 5, 1, 4, 1, 1, 4}, ReferencedSOPInstanceUID → {1, 3, 46, 670 589, 11, 0, 0, 11, 4, 2, 0, 10 453, 5, 4100, 2 005 032 222 092 871 499}}}
(0009,0010)	SECTRA_Ident_01
(0009,1001)	2200000000
(0009,1002)	00
PatientName	{Anonymous, Male 1958}
PatientID	GH−WISE:68736
PatientIDIssuer	anonymous
PatientBirthDate	anonymous
PatientBirthTime	anonymous
PatientSex	M
PatientBirthName	anonymous
PatientMotherBirthName	anonymous
MedicalRecordLocator	anonymous
MedicalAlerts	anonymous
ContrastAllergies	anonymous

ResidenceCountry	anonymous
ResidenceRegion	anonymous
PatientTelephoneNumbers	anonymous
EthnicGroup	anonymous
Occupation	anonymous
SmokingStatus	anonymous
PregnancyStatus	{12 336, 13 360}
PatientReligiousPreference	anonymous
PatientComments	anonymous
ScanningSequence	GR
SequenceVariant	SP
SliceThickness	1.6
RepetitionTime	25.
EchoTime	4.6012
InversionTime	0.
AveragesCount	4.
ImagingFrequency	63.8985
ImagedNucleus	1H
EchoNumbers	1
MagneticFieldStrength	1.5
SlicesSpacing	0.8
PhaseEncodingSteps	416
EchoTrainLength	0
PercentSampling	80.
PercentPhaseFieldOfView	79.8077
DeviceSerialNumber	10453
SoftwareVersions	{NT 10.3.1, PIIM V2.1.4.1 MIMIT MCS}
Protocol	T1/3D/FFE** SYN+
LowRRValue	0
HighRRValue	0

IntervalsAcquired	0
IntervalsRejected	0
HeartRate	0
ReconstructionDiameter	360.
ReceivingCoil	Syn−head/neck
TransmittingCoil	B
AcquisitionMatrix	{0, 416, 416, 0}
PhaseEncodingDirection	ROW
FlipAngle	30.
PatientPosition	HFS
StudyInstanceUID	{1, 3, 46, 670 589, 11, 0, 0, 11, 4, 2, 0, 10 453, 5, 3320, 2 005 032 222 082 070 828}
SeriesInstanceUID	{1, 3, 46, 670 589, 11, 0, 0, 11, 4, 2, 0, 10 453, 5, 3616, 2 005 032 222 133 460 760}
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SeriesNumber	2
AcquisitionNumber	3
InstanceNumber	101
ImagePosition	{14.8496, −201.474, 142.196}
ImageOrientation	{−0.0196207, 0.999807, 0., 0., 0., −1.}
ReferenceFrameUID	{1, 3, 46, 670 589, 11, 0, 0, 11, 4, 2, 0, 10 453, 5, 3616, 2 005 032 222 084 848 741}
TemporalPositionIdentifier	1
TemporalPositionCount	1
SliceLocation	79.9997
SamplesPerPixel	1
PhotometricInterpretation	MONOCHROME2
Rows	512
Columns	512
PixelSpacing	{0.703125, 0.703125}
PixelAspectRatio	{1, 1}
AllocatedBits	16
StoredBits	12

HighBit	11
PixelRepresentation	0
WindowCenter	994.
WindowWidth	1987.
RescaleIntercept	0.
RescaleSlope	1.53968
RescaleType	normalized
LossyImageCompression	00
StudyComments	TEST
PerformedStationAETitle	INTERA
PerformedProcedureStartDate	{2005, 3, 22}
PerformedProcedureStartTime	{22, 8, 40}
PerformedProcedureEndDate	{2005, 3, 22}
PerformedProcedureEndTime	{22, 8, 40}
PerformedProcedureID	164758100
PerformedProcedureDescription	TEST
RequestAttributesSequence	{}
PerformedProceduresComments	TEST
FilmConsumptionSequence	{}
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(2001,1002)	0
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(2001,1007)	U
(2001,1008)	1
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(2001,100A)	101
(2001,100B)	SAGITTAL
(2001,100C)	N

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(2001,1018)	220
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(2001,101A)	{0., 0., 0.}
(2001,101B)	0.
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(2001,1020)	T1FFE
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(2001,1024)	N
(2001,1025)	4.6
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(2001,1062)	N
(2001,1063)	ELSEWHERE
(2001,106E)	MRSERIES
(2001,107B)	3
(2001,1081)	1
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(2001,1088)	4.
(2001,1089)	0.
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(2001,108B)	B
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(2005,0011)	Philips MR Imaging DD 002
(2005,0012)	Philips MR Imaging DD 003
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(2005,100A)	11.3179
(2005,100B)	1.41824×10^6

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(2005,1035)	PIXEL
(2005,1036)	N
(2005,1037)	N
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(2005,103E)	{0, 0}
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(2005,1063)	0
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(2005,1086)	0
(2005,109E)	{}
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(2005,10A8)	0.
(2005,10B0)	0.
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(2005,10C0)	GR
(2005,1199)	0
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(2005,1201)	0

(2005,1243)	0
(2005,1244)	0
(2005,1245)	1
(2005,1246)	0
(2005,1247)	0
(2005,1248)	0
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(2005,1251)	0
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(2005,1254)	0
(2005,1255)	0
(2005,1325)	N
(2005,1326)	0.
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(2005,1328)	ORIGINAL
(2005,1329)	50.
(2005,1330)	{PLUS_A_PLUS_B, PLUS_A_PLUS_B, PLUS_A_PLUS_B, PLUS_A_PLUS_B}
(2005,1331)	0
(2005,1333)	{0., 0., 0.}
(2005,1334)	UNKNOWN
(2005,1335)	UNKNOWN
(2005,1336)	0.
(2005,1337)	0.
(2005,1338)	0.
(2005,1339)	{0, 0}
(2005,1340)	PRE_FT
(2005,1341)	UNKNOWN
(2005,1342)	FID

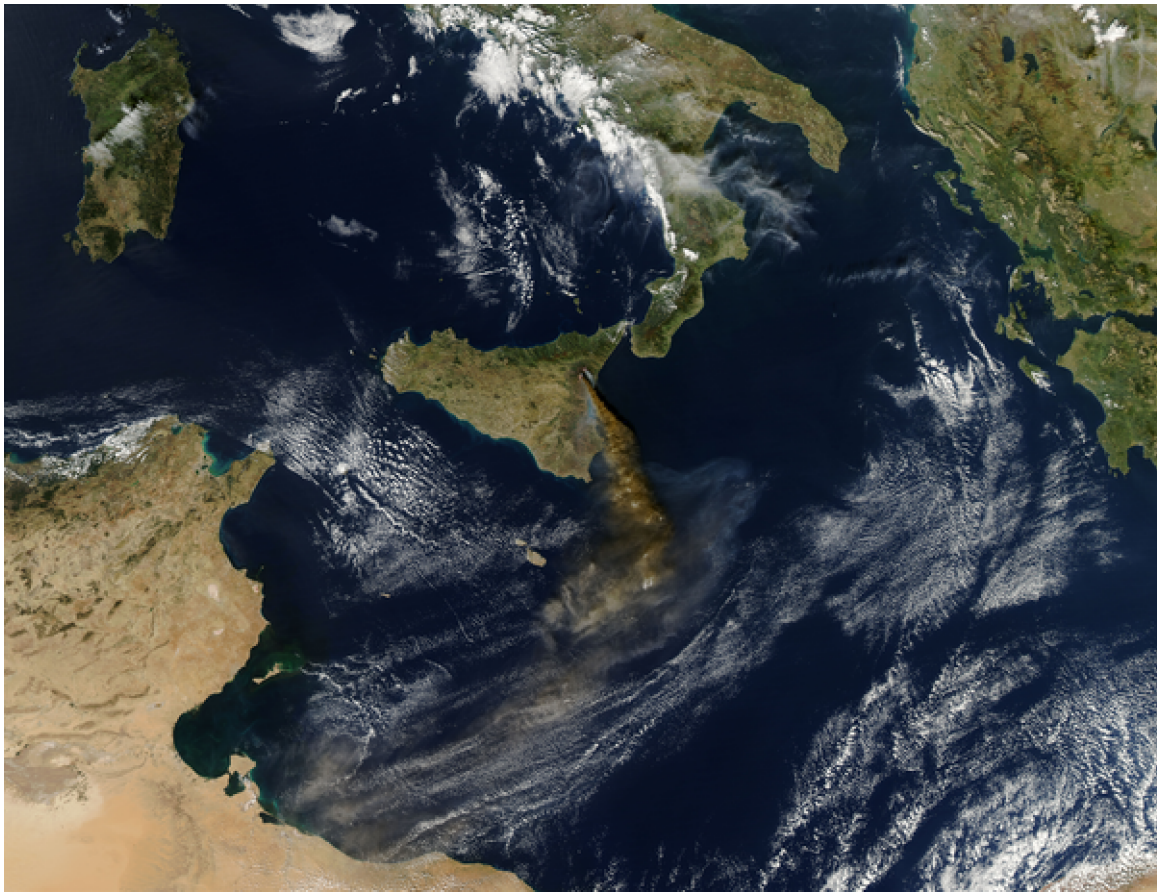
(2005,1343)	Y
(2005,1344)	{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}
(2005,1345)	NO
(2005,1346)	HERTZ
(2005,1347)	0.
(2005,1348)	OFF
(2005,1349)	0.
(2005,1350)	{0., 0.}
(2005,1351)	0
(2005,1352)	0
(2005,1355)	{0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.}
(2005,1356)	NO
(2005,1357)	0
(2005,1359)	1.
(2005,1360)	0.
(2005,1361)	{0., 0.}
(2005,1362)	0.
(2005,1363)	0.
(2005,1364)	NO
(2005,1370)	0
(2005,1371)	{}
(2005,1381)	3

Integrazione/interazione con altri ambienti: Import/Export di dati

Import è in grado di importare sia dal file system su cui è installato *Mathematica* sia da reti intranet/Internet, semplicemene attraverso l'URL.

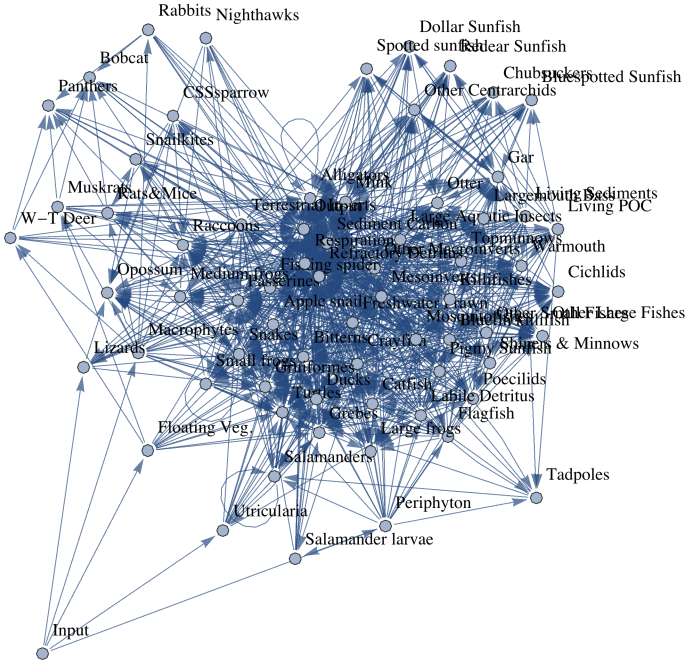
Questa è l'immagine dell'eruzione dell'Etna dell'Ottobre 2002 vista dal satellite Aqua

```
Import[
 "http://earthobservatory.nasa.gov/images/imagerecords/2000/2903/Sicily_AMO_2002301_lrg.jpg",
 ImageSize → {600, Automatic}]
```



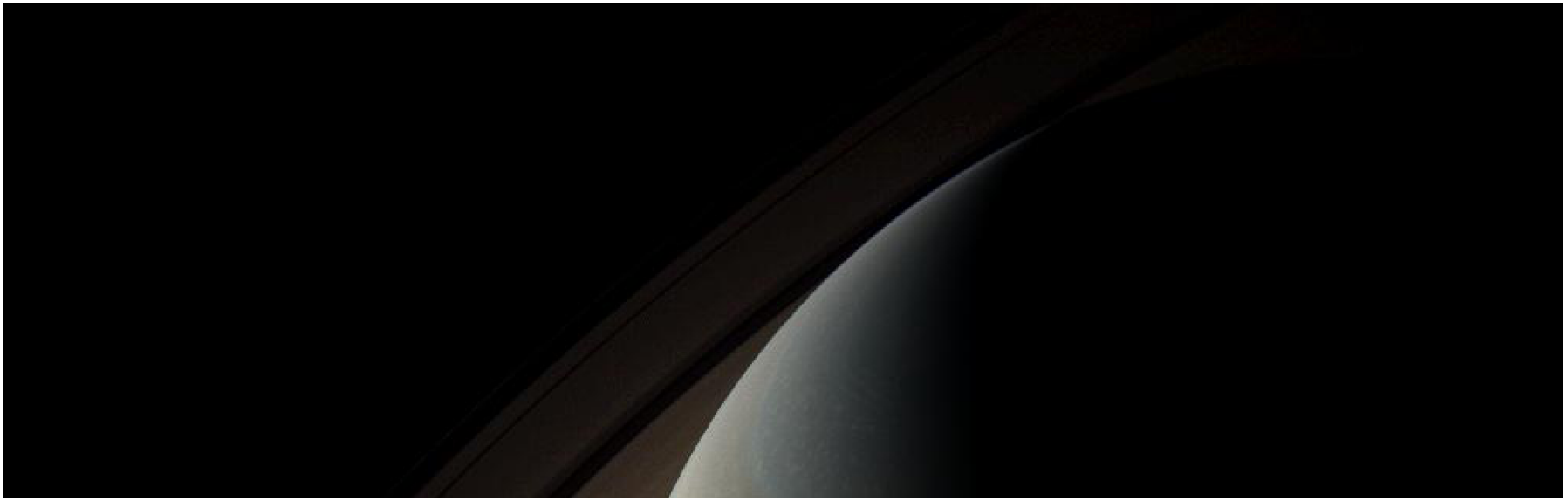
Import di un formato Graph (Pajek)

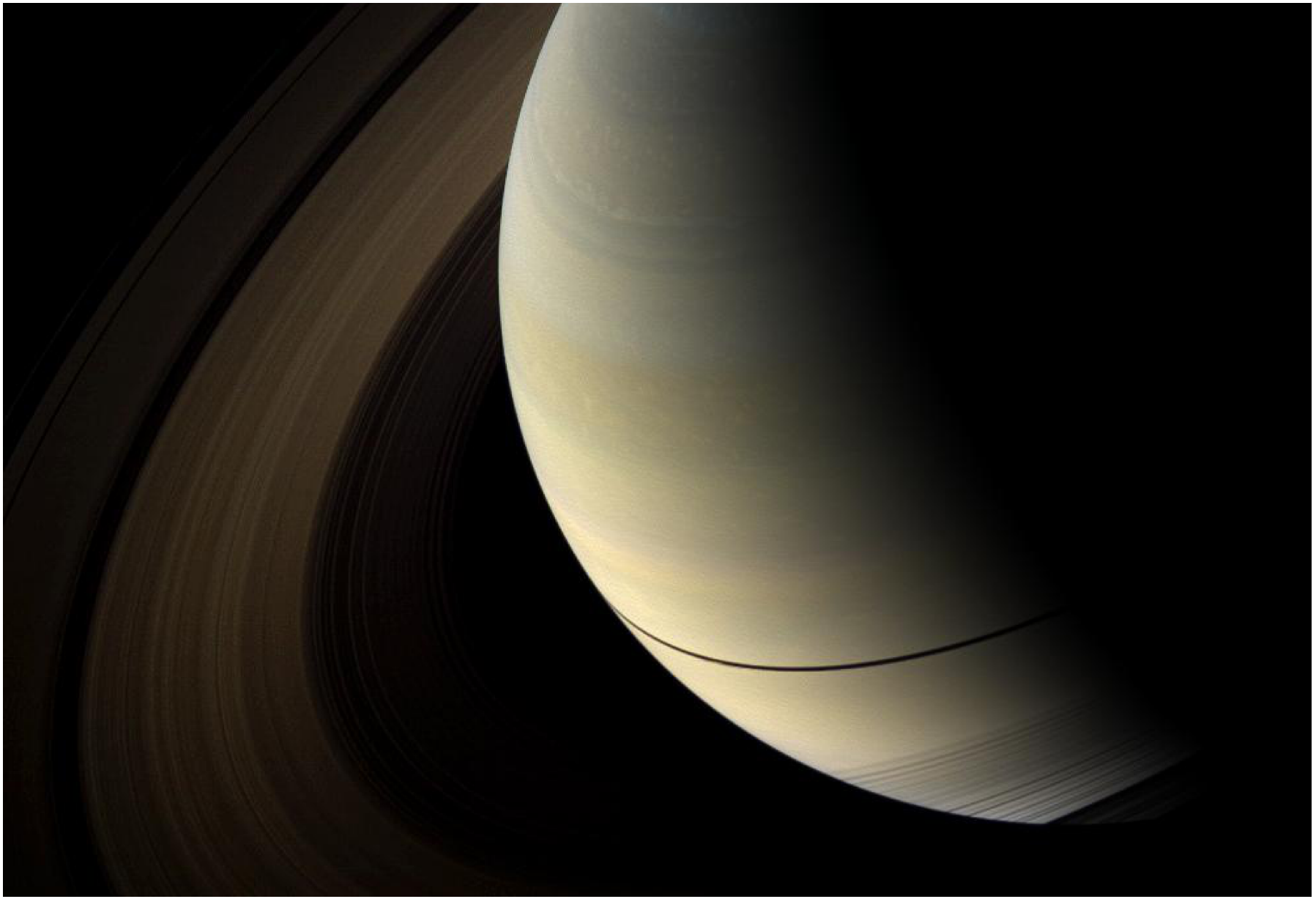
```
Import["http://vlado.fmf.uni-lj.si/pub/networks/data/bio/foodweb/Everglades.paj", "Pajek"]
```



Import di un file JPG

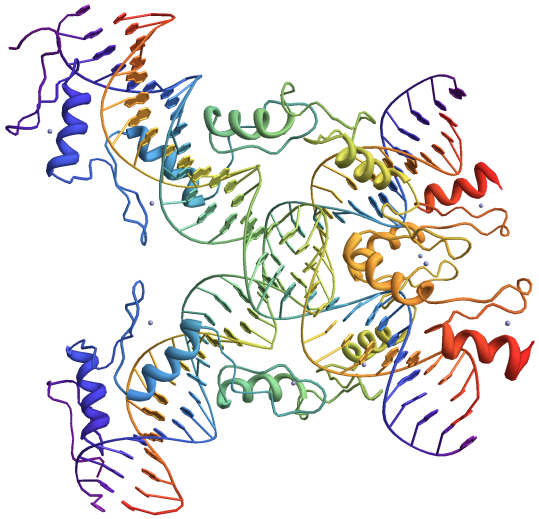
```
Import["http://photojournal.jpl.nasa.gov/jpeg/PIA12708.jpg"]
```





Una molecola in formato PDB

```
Import[
 "http://www.rcsb.org/pdb/download/downloadFile.do?fileFormat=pdb&compression=NO&structureId=1
   tf6", "PDB", ImageSize → Medium]
```



Integrazione/interazione con altri ambienti: Import/Export di dati

Vediamo qualche esempio di import di dati oltre che di immagini.

Importare direttamente da pagine HTML

Importiamo la pagina BLS web page

```
Import["http://www.bls.gov/web/laus/laumstrk.htm"]
```

Skip to Content

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Local Area Unemployment Statistics

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Local Area Unemployment Statistics
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DATA AVAILABILITY GEOGRAPHY
GEOGRAPHIC CONCEPTS METHODOLOGY
ESTIMATION METHODOLOGY
Unemployment Rates for States Unemployment Rates for States
Monthly Rankings
Seasonally Adjusted
Apr. 2014 p

Rank State Rate
1 NORTH DAKOTA 2.6
2 VERMONT 3.3

3 NEBRASKA 3.6
4 WYOMING 3.7
5 SOUTH DAKOTA 3.8
5 UTAH 3.8
7 IOWA 4.3
8 HAWAII 4.4
8 NEW HAMPSHIRE 4.4
10 LOUISIANA 4.5
11 OKLAHOMA 4.6
12 MINNESOTA 4.7
13 KANSAS 4.8
13 MONTANA 4.8
15 VIRGINIA 4.9
16 IDAHO 5.0
17 TEXAS 5.2
18 SOUTH CAROLINA 5.3
19 MARYLAND 5.5
20 INDIANA 5.7
20 MAINE 5.7
20 OHIO 5.7
20 PENNSYLVANIA 5.7
24 DELAWARE 5.8
24 WISCONSIN 5.8
26 COLORADO 6.0
26 MASSACHUSETTS 6.0
26 WEST VIRGINIA 6.0
29 WASHINGTON 6.1
30 FLORIDA 6.2
30 NORTH CAROLINA 6.2
32 TENNESSEE 6.3
33 ALASKA 6.4
34 ARKANSAS 6.6
34 MISSOURI 6.6

36 NEW YORK 6.7
37 NEW MEXICO 6.8
38 ALABAMA 6.9
38 ARIZONA 6.9
38 CONNECTICUT 6.9
38 NEW JERSEY 6.9
38 OREGON 6.9
43 GEORGIA 7.0
44 MICHIGAN 7.4
45 DISTRICT OF COLUMBIA 7.5
45 MISSISSIPPI 7.5
47 KENTUCKY 7.7
48 CALIFORNIA 7.8
49 ILLINOIS 7.9
50 NEVADA 8.0
51 RHODE ISLAND 8.3
p = preliminary.
NOTE: Rates shown are a percentage of the labor force. Data refer
to place of residence. Estimates for the current month are subject to revision the following month.

Last Modified Date: May 16, 2014

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Ovviamente risulta poco leggibile, ma se ci interessano i dati contenuti nella pagina possiamo scrivere qualche riga di codice che c consente di estrarre i soli dati numerici che ci interessano e convertirli facilmente in una tabella *Mathematica*:

```
data = Import["http://www.bls.gov/web/laus/laumstrk.htm", {"Data"}];
(* importa la pagina html *)
data2 = Cases[data, {_Integer, _String, _Real}, Infinity];
(* Estraiamo i soli dati{rank, STATE, rate} *)
results = data2[[All, {2, 3}]]; (* eliminiamo il rank *)
SortBy[results, First]; (* ordiniamo alfabeticamente *)
Grid[results, Alignment → Left, Frame → All, Background → LightYellow, BaseStyle → {"Menu"}]
(* creiamo una tabella *)
```

NORTH DAKOTA	2.6
VERMONT	3.3
NEBRASKA	3.6
WYOMING	3.7
SOUTH DAKOTA	3.8
UTAH	3.8
IOWA	4.3
HAWAII	4.4

NEW HAMPSHIRE	4.4
LOUISIANA	4.5
OKLAHOMA	4.6
MINNESOTA	4.7
KANSAS	4.8
MONTANA	4.8
VIRGINIA	4.9
IDAHO	5.
TEXAS	5.2
SOUTH CAROLINA	5.3
MARYLAND	5.5
INDIANA	5.7
MAINE	5.7
OHIO	5.7
PENNSYLVANIA	5.7
DELAWARE	5.8
WISCONSIN	5.8
COLORADO	6.
MASSACHUSETTS	6.
WEST VIRGINIA	6.
WASHINGTON	6.1
FLORIDA	6.2
NORTH CAROLINA	6.2
TENNESSEE	6.3
ALASKA	6.4
ARKANSAS	6.6
MISSOURI	6.6
NEW YORK	6.7

NEW MEXICO	6.8
ALABAMA	6.9
ARIZONA	6.9
CONNECTICUT	6.9
NEW JERSEY	6.9
OREGON	6.9
GEORGIA	7.
MICHIGAN	7.4
DISTRICT OF COLUMBIA	7.5
MISSISSIPPI	7.5
KENTUCKY	7.7
CALIFORNIA	7.8
ILLINOIS	7.9
NEVADA	8.
RHODE ISLAND	8.3

Volendo possiamo anche aggiungere l'intestazione di colonna interattiva:

```
Grid[{{Grid[
     {{Button[Style["State", {Blue, "Link"}], results = SortBy[results, First], Appearance → None],
       Button[Style["Rate", {Blue, "Link"}], results = SortBy[results, Last], Appearance → None]}},
     Alignment → {{Left, Right}}, ItemSize → 11]},
  {Dynamic[Grid[results, Alignment → {{Left, Right}}, Frame → All, ItemSize → 14]]}},
 Frame → True, Background → LightYellow,
 BaseStyle → {"Panel"}]
```

State	Rate

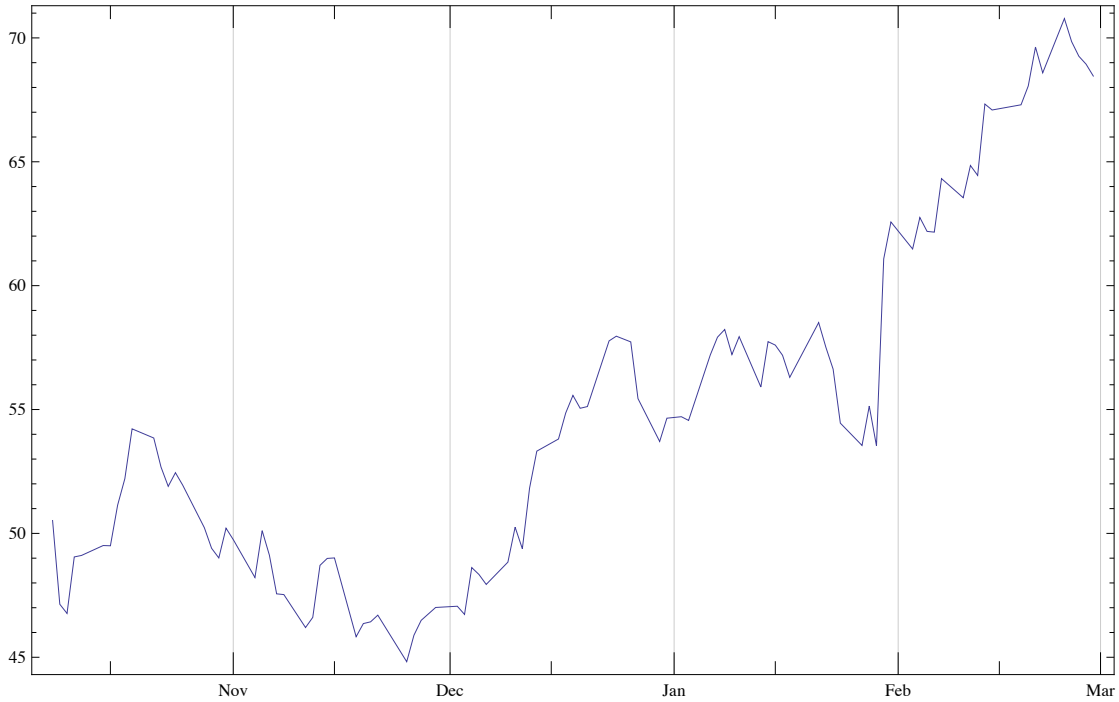
Grid[results, Alignment → (Left Right), Frame → All, ItemSize → 14]

Import dati finanziari.

Questo è un esempio di Import di dati dal sito http://finance.yahoo.com

```
facebook = Import[
   "http://ichart.finance.yahoo.com/table.csv?s=FB&d=2&e=2&f=2014&g=d&a=4&b=18&c=2012&ignore=.
     csv"];
```

```
DateListPlot[Part[Rest[facebook], 1 ;; 100, {1, 5}], Joined → True, ImageSize → Large]
```




```
$ExportFormats
```

{3DS, ACO, AIFF, AU, AVI, Base64, Binary, Bit, BMP, Byte, BYU, BZIP2, C, CDF, Character16, Character8, Complex128, Complex256 Complex64, CSV, CUR, DICOM, DIF, DIMACS, DOT, DXF, EMF, EPS, ExpressionML, FASTA, FASTQ, FCS, FITS, FLAC, FLV, GIF, Graph6, Graphlet, GraphML, GXL, GZIP, HarwellBoeing, HDF, HDF5, HTML, ICNS, ICO, Integer128, Integer16, Integer24, Integer32, Integer64, Integer8, JPEG, JPEG2000, JSON, JVX, KML, LEDA, List, LWO, MAT, MathML, Maya, MGF, MIDI, MOL, MOL2, MTX, MX, NASACDF, NB, NetCDF, NEXUS, NOFF, OBJ, OFF, Package, Pajek, PBM, PCX, PDB, PDF, PGM, PICT, PLY, PNG, PNM, POV, PPM, PXR, QuickTime, RawBitmap, Real128, Real32, Real64, RIB, RTF, SCT, SDF, SND, Sparse6, STL, String, SurferGrid, SVG, SWF, Table, TAR, TerminatedString, TeX, Text, TGA, TGF, TIFF, TSV, UnsignedInteger128, UnsignedInteger16, UnsignedInteger24, UnsignedInteger32, UnsignedInteger64, UnsignedInteger8, UUE, VideoFrames, VRML, VTK, WAV, Wave64, WDX, X3D, XBM, XHTML, XHTMLMathML, XLS, XLSX, XML, XYZ, ZIP, ZPR}

```
file = Export["//tmp//facebook.xls", facebook]
```

//tmp//facebook.xls

```
SystemOpen[file]
```

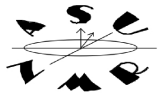
Integrazione/interazione con altri ambienti: Import/Export di dati

Un ultimo esempio di import documenti: il riconoscimento del testo.

```
SetDirectory[NotebookDirectory[]]
```

/Users/cgallo/Box Sync/Documenti/Universita/UNIFG/Didattica/Seminario Mathematica 2014

```
img = Import["zerofill.jpg"]
```



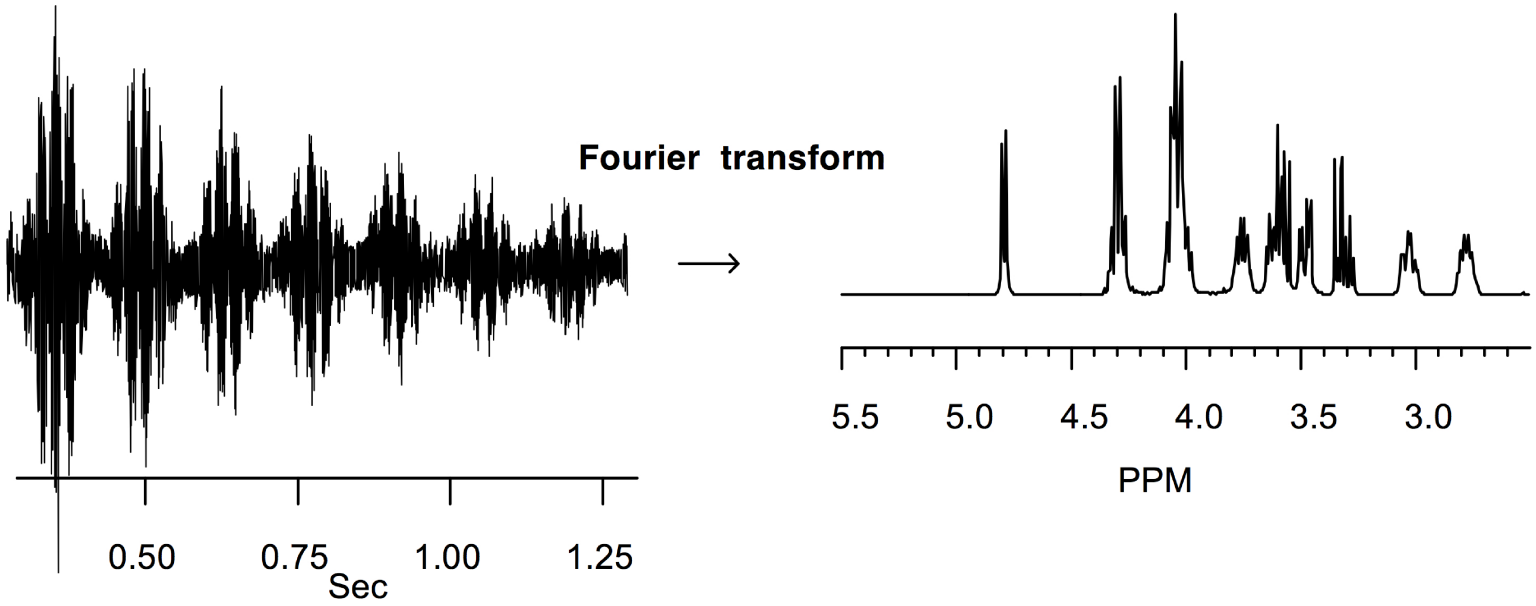
Zero-Filling in FT-NMR (version 1.0, 3Mar94) 1

I. Zero-Filling Data

A. Review of Fourier Transformation in NMR

Very briefly, the actual NMR spectrum acquired by a modern pulse fourier transform NMR spectrometer is called a free-induction decay or fid. This spectrum results when a sample in the presence of a large external magnetic field is subjected to a short (several microseconds), high-power pulse (50-1,000W) of radio-frequency energy at the resonance frequency of the nuclei of interest. This burst of energy is released by the sample over a much longer period of time (typically seconds) as the nuclear spins return to their equilibrium energy states. The released energy is emitted as a radio wave. The frequency of this wave is dependent upon the local magnetic environment of the nuclei. If the excited nuclei in a sample are all in the same magnetic environment, the observed signal will consist of a single decaying radio frequency (sine wave). If there are several magnetically inequivalent nuclei, each will release its absorbed energy at a slightly different frequency. The observed signal will consist of a decayingwaveform which is the sum of the individual decaying sine waves from each of the inequivalent nuclei. This signal *induces* a current in the nmr probe and the signal *decays* as the nuclei freely release their absorbed energy, hence the term free-induction decay.

The actual spectral data acquired by the NMR is the free-induction decay, or fid. The "spectrum" we always plot and interpret results from a mathematical manipulation (ft) of the acquired spectral data. In pulse ft-NMR, thefid is fourier transformed. The ft converts the AMPLITUDE vs. TIME domain information in thefid to the AMPLITUDE vs. FREQUENCY domain seen in the typical nmr "spectrum".



The continuous NMR radio-frequency signal f(t) emitted by the sample (for ^{1}H on the Gemini-300, the NMR signals occur at 300MHz, +/-several kilohertz) is reduced to the audio-frequency range by mixing out the high-frequency component. The low-frequency audio spectrum containing the NMR signals is then converted into a discrete series of data points by an analog-to-digital converter. The number of points that you acquire can be controlled with the parameter **np**. Alternatively, the acquisition time **at** can also be used to set the number of points. At a given sweep width, a longer value for **at** will always result in a greater number of data points **np**.

Zero-Filling Ft of Data

TextRecognize[img]

ev

wine Zem−Filling FT−NMH(versien aMar94} 1

I; ZEIO−Filling Data
A.. Review ofFou1−fer Transformation in NMR |
briefly, the actual NMR la modern pt11®111‘ieret1‘a11sf01‘n1
spectrometer is a neeanductie decay nfid. results whe as ple the
preseneeef a large external magnetic field 'is subjected te a short (several microseconds), highepower
pulse (50−1 of radio−frequency energy at the resonance frequency of the nuclei of interest. This
ef energy is released by the ssmple over a much longer of time sece ds) as the
nuclear spins return to their energy states. The released energy is emitted as a radio wave..
The frequency of this wave is dependent upon the local magnetic enviroment of the nuclei. the
excited nuclei in a sample are inthe same magnetic enviromnent, the observed si al censist
of a single decaying radio frequeney (sine wave), there are several magnetieallpequivalent
nuelei, each Will releaseits abso%ed energy ata slightly different frequency. The Observed signal will
consist nf an deeayingwavefonn whieh is the ofthe decaying sine waves each of
the 'inequivalent nuclei; This signalinducesea −eurrent in the n probe and the lsignaldecays as the
nuelei freely release their ahsowed energy, hence the term free−induction. decay.
The~aet11a1.speCtra;1.data by the N is the freeanduetion decay, The
d“speetrum" we always plot and interpret results from fa rnathernatieal manipulation (ft) ef the acquired
rspeetral pulse ft−NMR., thetid .isfeurier The ft converts the
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PPM
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The continuous radio,−frequency signalftd) emitted the sample €fo11H onthe
Ge ini−300, the ;sig a1s−occur at SDOMHZ, +/eseveral ki1ohertz)is reduced tothe audie−
frequeney range by itnixmgfout the high−frequency component. The Iowefrequeney audio spectrum
containing the NMR. is then converted into a discrete series of data points an analog−to~
converters... The number ofpoints you acquire can eontrolled the
A1ternative1y,,.the.acquisition.timeat can also he used to set the number ofpoints. At, a given sweep

a lenger value forat always result ina greater number of pointrnp.

Zero~.FilIiing

Ft of Data

Integrazione/interazione con altri ambienti: Import/Export di dati

Come esportare verso altri formati.

Ci sono due modi di esportare dati, immagini o documenti da *Mathematica*:

» **Save As** (menu File o menu contestuale)

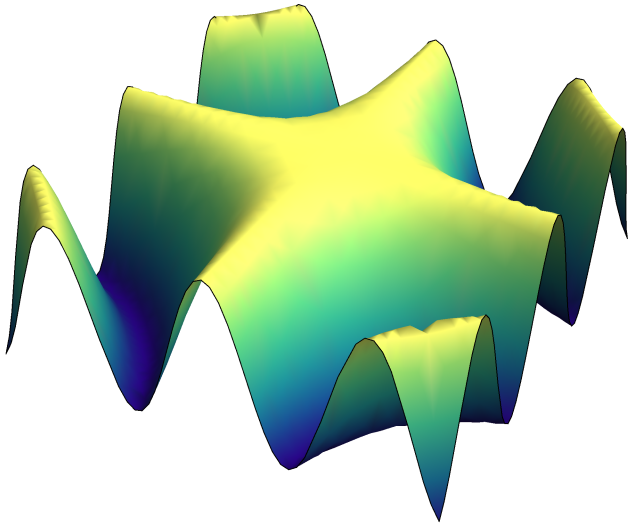
» **Export**

Save As è più rapido ma non consente di personalizzare il risultato ai livelli consentiti da **Export** tramite le opzioni. Comunqu anche **SaveAs** fornisce una serie di opzioni di base per il salvataggio dei file.

Integrazione/interazione con altri ambienti: Import/Export di dati

» Export

```
gr = Plot3D[Cos[x y], {x, -3, 3}, {y, -3, 3},
  ColorFunction → "BlueGreenYellow", Mesh → None, Boxed → False, Axes → False]
```

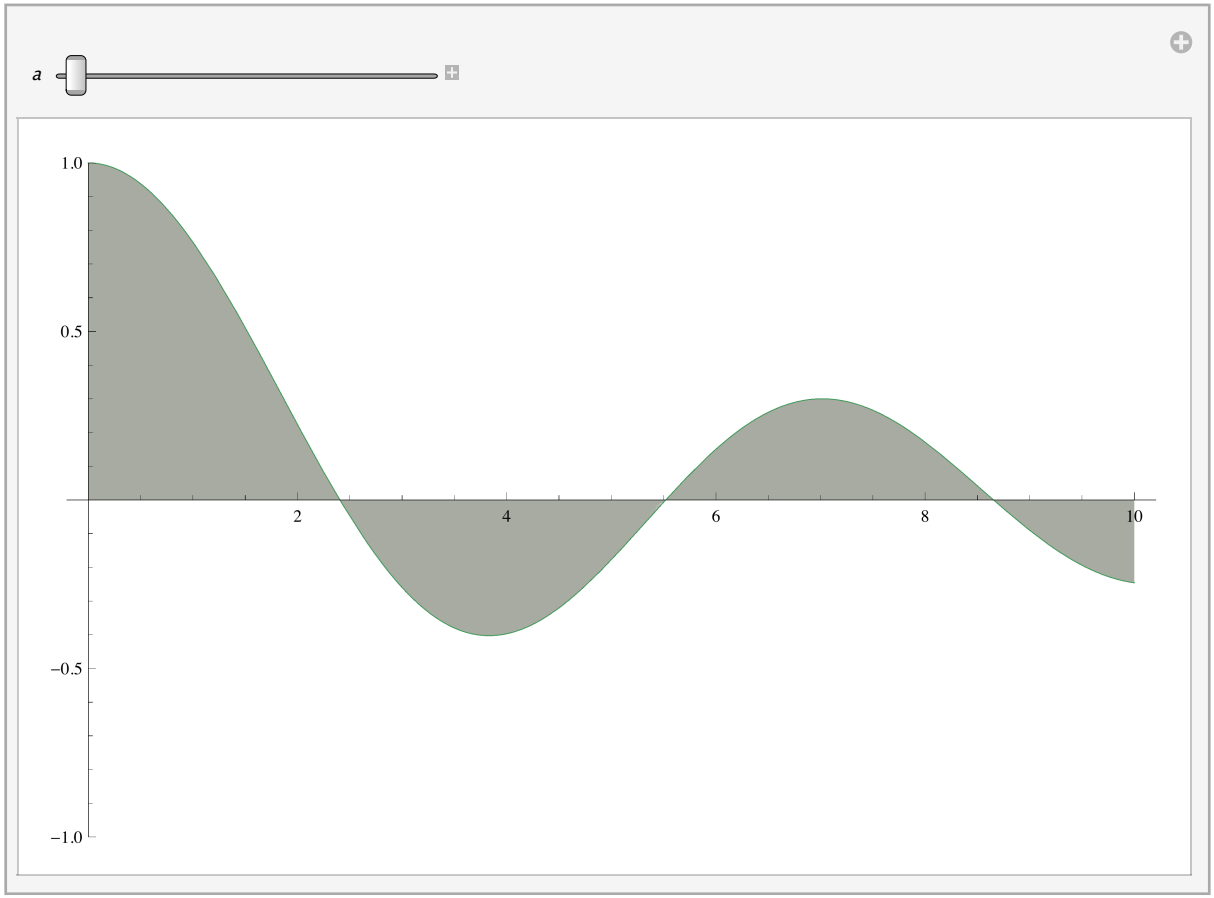


```
Export["Plot3D.jpg", gr, "ColorSpace" → "GrayLevel"]
```

Plot3D.jpg

Esportazione di una animazione

```
an = Manipulate[
  Plot[{BesselJ[a, x], BesselJ[2 a, x], BesselJ[3 a, x], BesselJ[4 a, x]},
   {x, 0, 10}, Filling → Automatic, PlotRange → 1, ImageSize → Large], {a, 0, 2}]
```

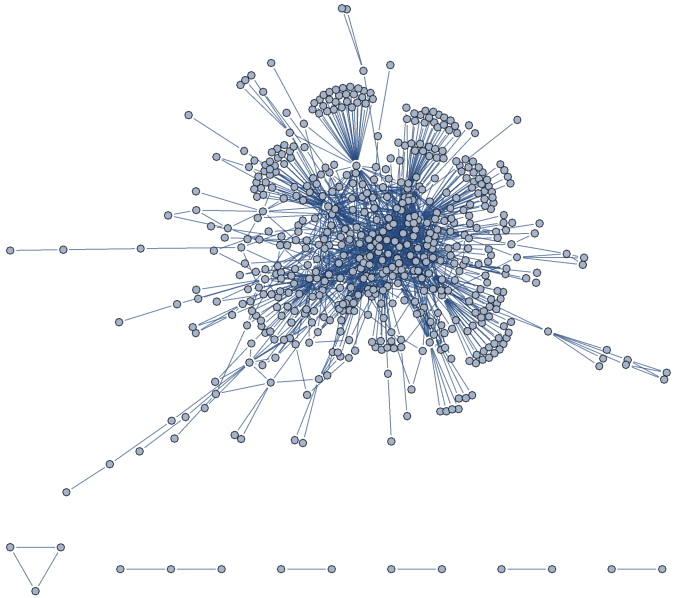



```
Export["BesselJCurves.avi", an];
```

```
SystemOpen["BesselJCurves.avi"]
```

Esportare dati articolati per mezzo di regole

```
gr = Import["http://mat.gsia.cmu.edu/COLOR/instances/homer.col", "DIMACS"]
```



Esportiamo un file TAR compresso composto da due file

```
Export["test.tar", {"photo.png" → gr,
  "description.txt" → "Relationships of characters in Homer's Iliad."}, {"Tar", "Rules"}]
```

test.tar

Integrazione/interazione con altri ambienti: Import/Export di dati

Una volta importati (o generati) i dati in *Mathematica* bisogna ancora prestare attenzione al modo in cui si intendono gestire e eventualmente ulteriormente salvare. Facciamo un esempio di ottimizzazione dei tempi di lettura/scrittura di grandi data set.

```
dati = RandomInteger[{-10, 10}, {10^5}];
```

Uno dei formati molto diffusi è il “Comma Separated Value” (CSV). Questo formato è comodo perchè i file sono ASCII e dunqu leggibili con qualsiasi editor come Notepad o simili. Lo svantaggio è che sono “pesanti” e rallentano i processi di import export.

```
AbsoluteTiming[Export["dati.csv", dati]]
```

{1.110613, dati.csv}

```
FileInformation["dati.csv", "ByteCount"]
```

257 105

```
AbsoluteTiming[t = Flatten[Import["dati.csv"]];]
```

{0.995028, Null}

Proviamo con il formato Binary

```
AbsoluteTiming[
 BinaryWrite["dati", dati, "Integer16"];
 Close["dati"]]
```

{0.002782, dati}

```
FileInformation["dati", "ByteCount"]
```

200 000

```
AbsoluteTiming[
 stream = OpenRead["dati", BinaryFormat → True];
 tt = BinaryReadList["dati", "Integer16"];
 Close[stream]]
```

{0.003106, dati}

```
t === tt === dati
```

True

Un ulteriore vantaggio si ha se i dati in questione vengono frequentemente aggiornati con l'aggiunta di qualche riga.

```
new = RandomInteger[{-10, 10}, {10}];
```

```
AbsoluteTiming[Export["dati.csv", Join[Flatten[Import["dati.csv"]], new]];]
```

{1.899962, Null}

```
AbsoluteTiming[
 stream = OpenAppend["dati", BinaryFormat → True];
 BinaryWrite[stream, new, "Integer16"];
 Close[stream]]
```

{0.000141, dati}

```
t = Flatten[Import["dati.csv"]];
```

```
AbsoluteTiming[
 stream = OpenRead["dati", BinaryFormat → True];
 tt = BinaryReadList["dati", "Integer16"];
 Close[stream]]
```

{0.002640, dati}

```
t === tt === Join[dati, new]
```

True

Integrazione/interazione con altri ambienti: Import/Export di dati

Un altro importantissimo aspetto legato alla gestione dei dati è quello dei database. Anche in questo caso *Mathematica* com prende la tecnologia necessaria per l'integrazione immediata ed altamente flessibile: Database Connectivity

```
(* Esempi *)
```

```
Import["ExampleData/buildings.mdb"]
```

({1, Taipei 101, Taipei, Taiwan, 2004, 101, 508} {2, Petronas Tower 1, Kuala Lumpur, Malaysia, 1998, 88, 452} {3, Petronas Tower 2, Ku

```
Needs["DatabaseLink`"];
conn = OpenSQLConnection[ "publisher"];
```

```
<< DatabaseLink`DatabaseExamples`;
DatabaseExamplesBuild[]
```

Seleziono tutti i dati da una tabella:

```
SQLSelect[conn, "ROYSCHED"]
```

BS1011	0	5000	0.1
BS1011	5001	50 000	0.12
CP5018	0	2000	0.1
CP5018	2001	4000	0.12
CP5018	4001	50 000	0.16
BS1001	0	1000	0.1
BS1001	1001	5000	0.12
BS1001	5001	7000	0.16
BS1001	7001	50 000	0.18
PS9999	0	50 000	0.1
PY2002	0	1000	0.1
PY2002	1001	5000	0.12
PY2002	5001	50 000	0.14
PY2003	0	2000	0.1
PY2003	2001	5000	0.12

PY2003	5001	50000	0.14
UK3004	0	1000	0.1
UK3004	1001	2000	0.12
UK3004	2001	6000	0.14
UK3004	6001	8000	0.18
UK3004	8001	50000	0.2
CK4005	0	2000	0.1
CK4005	2001	6000	0.12
CK4005	6001	8000	0.16
CK4005	8001	50000	0.16
CP5010	0	5000	0.1
CP5010	5001	50000	0.12
PY2012	0	5000	0.1
PY2012	5001	50000	0.12
PY2013	0	5000	0.1
PY2013	5001	50000	0.12
UK3006	0	1000	0.1
UK3006	1001	2000	0.12
UK3006	2001	6000	0.14
UK3006	6001	8000	0.18
UK3006	8001	50000	0.2
BS1014	0	4000	0.1
BS1014	4001	8000	0.12
BS1014	8001	50000	0.14
UK3015	0	2000	0.1
UK3015	2001	4000	0.12
UK3015	4001	8000	0.14
UK3015	8001	12000	0.16
CK4016	0	5000	0.1
CK4016	5001	15000	0.12
CK4017	0	2000	0.1

CK4017	2001	8000	0.12
CK4017	8001	16000	0.14
BS1007	0	5000	0.1
BS1007	5001	50000	0.12
PY2008	0	50000	0.1

Seleziono solo determinate colonne:

```
Grid[SQLSelect[conn, "ROYSCHED", {"TITLE_ID", "ROYALTY"}]]
```

BS1011	0.1
BS1011	0.12
CP5018	0.1
CP5018	0.12
CP5018	0.16
BS1001	0.1
BS1001	0.12
BS1001	0.16
BS1001	0.18
PS9999	0.1
PY2002	0.1
PY2002	0.12
PY2002	0.14
PY2003	0.1
PY2003	0.12
PY2003	0.14
UK3004	0.1
UK3004	0.12
UK3004	0.14
UK3004	0.18
UK3004	0.2
CK4005	0.1
CK4005	0.12

CK4005	0.16
CK4005	0.16
CP5010	0.1
CP5010	0.12
PY2012	0.1
PY2012	0.12
PY2013	0.1
PY2013	0.12
UK3006	0.1
UK3006	0.12
UK3006	0.14
UK3006	0.18
UK3006	0.2
BS1014	0.1
BS1014	0.12
BS1014	0.14
UK3015	0.1
UK3015	0.12
UK3015	0.14
UK3015	0.16
CK4016	0.1
CK4016	0.12
CK4017	0.1
CK4017	0.12
CK4017	0.14
BS1007	0.1
BS1007	0.12
PY2008	0.1

Unisco i dati da più tabelle:

```
SQLSelect[conn, {"TITLES", "ROYSCHED"},
  {{"TITLES", "TITLE"}, {"TITLES", "TITLE_ID"}, {"ROYSCHED", "ROYALTY"}},
  SQLColumn[{"TITLES", "TITLE_ID"}] == SQLColumn[{"ROYSCHED", "TITLE_ID"}]] // Short[#, 25] &
```

Designer Class Action Suits	BS1001	0.1
Designer Class Action Suits	BS1001	0.12
Designer Class Action Suits	BS1001	0.16
Designer Class Action Suits	BS1001	0.18
Self Hypnosis: A Beginner's Guide	PY2002	0.1
Self Hypnosis: A Beginner's Guide	PY2002	0.12
Self Hypnosis: A Beginner's Guide	PY2002	0.14
Phobic Psychology	PY2003	0.1
Phobic Psychology	PY2003	0.12
Phobic Psychology	PY2003	0.14
Hamburger Again!	UK3004	0.1
Hamburger Again!	UK3004	0.12
Hamburger Again!	UK3004	0.14
Hamburger Again!	UK3004	0.18
Hamburger Again!	UK3004	0.2
Made to Wonder: Cooking the Macabre	CK4005	0.1
Made to Wonder: Cooking the Macabre	CK4005	0.12
Made to Wonder: Cooking the Macabre	CK4005	0.16
Made to Wonder: Cooking the Macabre	CK4005	0.16
How to Burn a Compact Disk	UK3006	0.1
How to Burn a Compact Disk	UK3006	0.12
How to Burn a Compact Disk	UK3006	0.14
How to Burn a Compact Disk	UK3006	0.18
How to Burn a Compact Disk	UK3006	0.2
Modems for Morons	BS1007	0.1
Modems for Morons	BS1007	0.12
How Green Is My Valley?	PY2008	0.1
Taiwan Trails	CP5010	0.1

Taiwan Trails	CP5010	0.12
Guide to Impractical Databases	BS1011	0.1
Guide to Impractical Databases	BS1011	0.12
Know Thyself	PY2012	0.1
Know Thyself	PY2012	0.12
Where Minds Meat: The Impact of Diet on Behavior	PY2013	0.1
Where Minds Meat: The Impact of Diet on Behavior	PY2013	0.12
Exit Interviews	BS1014	0.1
Exit Interviews	BS1014	0.12
Exit Interviews	BS1014	0.14
Treasures of the Sierra Madre	UK3015	0.1
Treasures of the Sierra Madre	UK3015	0.12
Treasures of the Sierra Madre	UK3015	0.14
Treasures of the Sierra Madre	UK3015	0.16
Too Many Cooks	CK4016	0.1
Too Many Cooks	CK4016	0.12
Let Them Eat Cake!	CK4017	0.1
Let Them Eat Cake!	CK4017	0.12
Let Them Eat Cake!	CK4017	0.14
Sticky Software: UI and GUI	CP5018	0.1
Sticky Software: UI and GUI	CP5018	0.12
Sticky Software: UI and GUI	CP5018	0.16

Seleziono i dati che soddisfano una condizione:

```
SQLSelect[conn, "ROYSCHED", {"TITLE_ID", "ROYALTY"}, .10 < SQLColumn["ROYALTY"] < .15]
```

BS1011	0.12
CP5018	0.12
BS1001	0.12
PY2002	0.12
PY2002	0.14
PY2003	0.12
PY2003	0.14
UK3004	0.12
UK3004	0.14
CK4005	0.12
CP5010	0.12
PY2012	0.12
PY2013	0.12
UK3006	0.12
UK3006	0.14
BS1014	0.12
BS1014	0.14
UK3015	0.12
UK3015	0.14
CK4016	0.12
CK4017	0.12
CK4017	0.14
BS1007	0.12

Seleziono i dati che soddisfano un pattern:

```
SQLSelect[conn, "ROYSCHED", {"TITLE_ID", "ROYALTY"},
 SQLStringMatchQ[SQLColumn["TITLE_ID"], "C%"]]
```

CP5018	0.1
CP5018	0.12
CP5018	0.16
CK4005	0.1
CK4005	0.12
CK4005	0.16
CK4005	0.16
CP5010	0.1
CP5010	0.12
CK4016	0.1
CK4016	0.12
CK4017	0.1
CK4017	0.12
CK4017	0.14

Seleziono i dati che soddisfano una lista:

```
SQLSelect[conn, "ROYSCHED", {"TITLE_ID", "ROYALTY"},
 SQLMemberQ[{.14, .16}, SQLColumn["ROYALTY"]]]
```

CP5018	0.16
BS1001	0.16
PY2002	0.14
PY2003	0.14
UK3004	0.14
CK4005	0.16
CK4005	0.16
UK3006	0.14
BS1014	0.14
UK3015	0.14
UK3015	0.16
CK4017	0.14

Chiudo la connessione al database di esempio:

```
CloseSQLConnection[conn]
```

{SQLConnection(publisher, 1, Open, TransactionIsolationLevel → ReadCommitted)}

Integrazione/interazione con altri ambienti: Import/Export di dati

Le banche dati

» GenomeData

Il cromosoma 22

```
GenomeData["Chromosome22Genes"]
```

{A26C3, A4GALT, ABCD1P4, ACF, ACO2, ACR, ADM2, ADORA2A, ADPRTL4, ADRBK2, ADSL, ADTB1L1, ADTB1L2, AIFM3, ALG12, ANKRD54, ANTP3, AP1B1, APOBEC3A, APOBEC3B, APOBEC3C, APOBEC3D, APOBEC3F, APOBEC3G, APOBEC3H, APOL1, APOL2, APOL3, APOL4, APOL5, APOL6, ARFGAP3, ARHGAP8, ARSA, ARVCF, ASCC2, ASH2LP1, ASLL, ASPHD2, ATF4, ATP5L2, ATP6V1E1, ATXN10, BAIAP2L2, BCL2L13, BCR, BCRL2, BCRL3, BCRL4, BCRL5, BCRL6, BID, BIK, BMP6P1, BP38, BP55, BPIL2, BRD1, C1QTNF6, C22CTA250D109, C22orf10, C22orf13, C22orf15, C22orf17, C22orf23, C22orf24, C22orf25, C22orf26, C22orf27, C22orf28, C22orf29, C22orf30, C22orf31, C22orf32, C22orf33, C22orf34, C22orf36, C22orf37, C22orf39, C22orf40, C22orf9, C22RP185F182, CABIN1, CABP7, CACNA1I, CACNG2, CARD10, CBX6, CBX7, CBY1, CCDC116, CCDC117, CCDC134, CCT8L2, CDAGS, CDC42EP1, CDC45L, CECR, CECR1, CECR2, CECR3, CECR4, CECR5, CECR6, CECR7, CECR8, CECR9, CELSR1, CENPM, CERK, CHADL, CHCHD10, CHEK2, CHKB, CHKBCPT1B, CLCP1, CLDN5, CLTCL1, CN5H64, COMT, COPD4, COX5BL7, COX6BP3, COX7BP1, CPSF1P1, CPT1B, CRELD2, CRKL, CRYBA4, CRYBB1, CRYBB2, CRYBB2P1, CRYBB3, CSDC2, CSF2RB, CSF2RB2, CSNK1E, CTA126B43, CTA216E106, CTA221G94, CTA229A82, CYB5R3, CYP2D6, CYP2D7P1, CYP2D7P2, CYP2D8P1, CYP2D8P2, DDT, DDTL, DDX17, DEPDC5, DERL3, DFNB40, DGCR, DGCR10, DGCR11, DGCR12, DGCR14, DGCR2, DGCR5, DGCR6, DGCR6L, DGCR7, DGCR8, DGCR9, DJ1033E151, DJ222E132, DKFZp434K191, DKFZP434P211, DKFZp547B139, DMC1, DNAJB7, DNAL4, DNM1DN18, DRG1, DUSP18, DUXAP8, DVL1L1, EFCAB6, EIF3D, EIF3EIP, EIF4ENIF1, ELFN2, EMID1, ENTHD1, EP300, EWSR1, FABP5L11, FAM108A5, FAM109B, FAM116B, FAM118A, FAM152B, FAM19A5, FAM32B, FAM83F, FBLN1, FBXO7, FLJ20464, FLJ23185, FLJ23865, FLJ26056, FLJ27365, FLJ30901, FLJ32575, FLJ32756, FLJ34651, FLJ38343, FLJ39582, FLJ42953, FLJ43315, FLJ44385, FLJ90680, FOXRED2, FPEVF, FRA22A, FRA22B, GAB4, GAL3ST1, GALR3, GAS2L1, GCAT, GGA1, GGT1, GGT2, GGT3P, GGT5, GGTLC2, GGTLC3, GGTLC4P, GGTLC5P, GNAZ, GNB1L, GP1BB, GRAMD4, GRAP2, GSC2, GSTT1, GSTT2, GSTT2B, GSTTP1, GSTTP2, GTPBP1, GTSE1, H1F0, HCG17241, HDAC10, HIC2, HIRA, HMG17L1, HMG17L2, HMG1L10, HMG2L1, HMOX1, HORMAD2, HPS4, HSCB, HTF9C, HUMYZ82H07, IGKV1OR221, IGKV1OR225, IGKV2OR223, IGKV2OR224,

IGKV3OR222, IGL@, IGLC@, IGLC1, IGLC2, IGLC3, IGLC4, IGLC5, IGLC6, IGLC7, IGLCOR221, IGLCOR222, IGLJ@, IGLJ1, IGLJ2, IGLJ3, IGLJ4, IGLJ5, IGLJ6, IGLJ7, IGLL1, IGLL2, IGLL3, IGLV@, IGLV1054, IGLV1067, IGLV1155, IGLV136, IGLV140, IGLV141, IGLV144, IGLV147, IGLV150, IGLV151, IGLV162, IGLV211, IGLV214, IGLV218, IGLV223, IGLV228, IGLV233, IGLV234, IGLV25, IGLV28, IGLV31, IGLV310, IGLV312, IGLV313, IGLV315, IGLV316, IGLV317, IGLV319, IGLV32, IGLV321, IGLV322, IGLV324, IGLV325, IGLV326, IGLV327, IGLV329, IGLV330, IGLV331, IGLV332, IGLV34, IGLV36, IGLV37, IGLV39, IGLV43, IGLV460, IGLV469, IGLV537, IGLV539, IGLV545, IGLV548, IGLV552, IGLV657, IGLV735, IGLV743, IGLV746, IGLV861, IGLV949, IGLVI20, IGLVI38, IGLVI42, IGLVI56, IGLVI63, IGLVI68, IGLVI70, IGLVIV53, IGLVIV59, IGLVIV64, IGLVIV65, IGLVIV661, IGLVIVOR221, IGLVIVOR222, IGLVV58, IGLVV66, IGLVVI221, IGLVVI251, IGLVVII411, IL17RA, IL17REL, IL2RB, ISX, ITS, JOSD1, KAZA, KCNJ4, KCNMB3L, KCTD17, KDELR3, KIAA1648, KIAA1652, KIAA1654, KIAA1655, KIAA1656, KIAA1659, KIAA1661, KLHDC7B, KLHL22, KREMEN1, KRT18P23, KRT18P5, L3MBTL2, LARGE, LDOC1L, LGALS1, LGALS2, LIF, LIMK2, LL22NC0375B36, LMF2, LOC100113375, LOC100127979, LOC100128009, LOC100128138, LOC100128147, LOC100128279, LOC100128388, LOC100128393, LOC100128394, LOC100128400, LOC100128401, LOC100128525, LOC100128526, LOC100128530, LOC100128531, LOC100128533, LOC100128535, LOC100128677, LOC100128716, LOC100128943, LOC100128946, LOC100129113, LOC100129224, LOC100129225, LOC100129254, LOC100129262, LOC100129358, LOC100129359, LOC100129360, LOC100129389, LOC100129643, LOC100129647, LOC100129648, LOC100129803, LOC100129936, LOC100129939, LOC100129944, LOC100130079, LOC100130194, LOC100130269, LOC100130338, LOC100130339, LOC100130420, LOC100130493, LOC100130496, LOC100130558, LOC100130561, LOC100130624, LOC100130708, LOC100130709, LOC100130715, LOC100130773, LOC100130828, LOC100130899, LOC100131052, LOC100131298, LOC100131299, LOC100131314, LOC100131322, LOC100131346, LOC100131404, LOC100131405, LOC100131424, LOC100131530, LOC100131536, LOC100131537, LOC100131579, LOC100131620, LOC100131667, LOC100131702, LOC100131753, LOC100131802, LOC100131861, LOC100131872, LOC100132029, LOC100132032, LOC100132082, LOC100132173, LOC100132176, LOC100132273, LOC100132295, LOC100132389, LOC100132451, LOC100132621, LOC100132705, LOC100132706, LOC100132723, LOC100132900, LOC100133040, LOC100133041, LOC100133043, LOC100133044, LOC100133064, LOC100133143, LOC100133163, LOC100133167, LOC100133224, LOC100133475, LOC100133478, LOC100133614, LOC100133843, LOC100133850, LOC100133887, LOC100133919, LOC100133922, LOC100134027, LOC100134031, LOC100134074, LOC100134107, LOC100134194, LOC100134361, LOC100134400, LOC100134402, LOC100134421, LOC129026, LOC150166, LOC150185, LOC150287, LOC150381, LOC150417, LOC246785, LOC284861, LOC284865, LOC284889, LOC284890, LOC284898, LOC284912, LOC284926, LOC284930, LOC284933, LOC284939, LOC339666, LOC339674, LOC339685, LOC376818, LOC386610, LOC388849, LOC388882, LOC388885, LOC388889, LOC388906, LOC388907, LOC388915, LOC391322, LOC391334, LOC400879, LOC400891, LOC400927, LOC402036, LOC402057, LOC440786, LOC440792, LOC440795, LOC440817, LOC440821, LOC440836, LOC441996, LOC51233, LOC550631, LOC553158, LOC554174, LOC641379, LOC641457,

LOC642619, LOC642633, LOC642643, LOC642648, LOC643069, LOC643102, LOC643653, LOC644079, LOC644165, LOC644186, LOC644339, LOC644525, LOC644618, LOC644652, LOC644768, LOC644773, LOC644899, LOC645280, LOC645348, LOC645390, LOC645904, LOC645964, LOC646074, LOC646216, LOC646408, LOC646467, LOC646756, LOC646851, LOC648218, LOC648691, LOC648771, LOC648980, LOC649017, LOC649095, LOC649264, LOC651158, LOC652968, LOC653135, LOC653184, LOC653203, LOC653264, LOC653881, LOC692231, LOC692246, LOC727731, LOC727962, LOC727983, LOC727996, LOC728139, LOC728212, LOC728216, LOC728253, LOC728351, LOC728418, LOC728438, LOC728451, LOC728468, LOC728474, LOC728877, LOC728897, LOC729057, LOC729166, LOC729212, LOC729314, LOC729444, LOC729461, LOC729526, LOC729568, LOC729832, LOC729980, LOC730005, LOC730163, LOC730668, LOC730990, LOC731062, LOC731957, LOC768328, LOC780780, LOC90834, LOC91219, LOC91316, LOC96610, LRE1, LRP5L, LZTR1, MAFF, MAP3K7IP1, MAPK1, MAPK11, MAPK12, MAPK8IP2, MB, MCAT, MCHR1, MCM5, MED15, MEI1, MFNG, MGAT3, MGC15705, MGC16703, MGC20647, MGC70863, MGCR, MIAT, MICAL3, MICALL1, MIF, MIOX, MIRN130B, MIRN185, MIRN301B, MIRN33A, MIRN648, MIRN649, MIRN650, MIRN658, MIRN659, MIRNLET7A3, MIRNLET7B, MKL1, MLC1, MMP11, MN1, MORC2, MOV10L1, MPPED1, MPST, MRPL40, MRPS16P3, MRPS18CP6, MTMR3, MTP18, MYH9, MYO18B, MYP6, NAGA, NCAPH2, NCF4, NDUFA6, NDUFA9P1, NEFH, NF1L6, NF2, NFAM1, NHP2L1, NIPSNAP1, NOL12, NPTXR, NUP50, OGS2, OPA5, OPHN1P1, OR11H1, OSBP2, OSM, P2RX6, P2RX6P, PACSIN2, PANX2, PARVB, PARVG, PATZ1, PDGFB, PDXP, PES1, PEX26, PHF21B, PHF5A, PI4KA, PI4KAP1, PI4KAP2, PIB5PA, PICK1, PIK3IP1, PIM3, PISD, PITPNB, PIWIL3, PKDREJ, PLA2G3, PLA2G6, PLXNB2, PMM1, PNPLA3, PNPLA5, POLDIP3, POLR2F, POLR3H, POM121L1, POM121L4P, PPARA, PPIL2, PPM1F, PPP1R14BP1, PRAME, PRAMEL, PRODH, PRR5, PSCD4, PsiTPTE22, PTPNS1L, PVALB, RAB36, RABL2B, RABL4, RAC2, RANBP1, RANGAP1, RASD2, RASL10A, RBM9, RBX1, RFPL1, RFPL1S, RFPL2, RFPL3, RFPL3S, RGL4, RHBDD3, RIBC2, RIMBP3, RIMBP3B, RIMBP3C, RN7SLP3, RNF185, RNF215, RNR5, RNU12P, RNU13P1, RNU86, RP11191L91, RP1127L46, RP1199H161, RP3402G115, RP3474I125, RPL3, RPL32L2, RPL41P3, RPS17P4, RPS19BP1, RPS9P2, RTDR1, RTN4R, SAMM50, SAPS2, SBF1, SCARF2, SCO2, SCUBE1, SCZD4, SDC4P, SDF2L1, SEC14L2, SEC14L3, SEC14L4, SELM, SEPT3, SEPT5, SERHL, SERHL2, SERPIND1, SEZ6L, SF3A1, SFI1, SGSM1, SGSM3, SH3BP1, SHANK3, SHFM3P1, SLC16A8, SLC25A1, SLC25A17, SLC25A18, SLC25A5P1, SLC2A11, SLC35E4, SLC5A1, SLC5A4, SLC7A4, SLC9A3P2, SMARCB1, SMC1B, SMCR7L, SMTN, SNAP29, SNORD125, SNORD43, SNORD83A, SNORD83B, SNRPD3, SOCS2P2, SOX10, SPECC1L, SREBF2, SRRD, SSTR3, ST13, SULT4A1, SUSD2, SUSD2P1, SYN3, SYNGR1, TBC1D10A, TBC1D22A, TBX1, TCF20, TCN2, TEF, TERF2IPP1, TFIP11, THAP7, THOC5, TI227H, TIMP3, TMEM184B, TMEM191A, TMEM191B, TMEM191C, TMEM211, TMPRSS6, TNFRSF13C, TNRC6B, TOB2, TOM1, TOMM22, TOP1P2, TOP3B, TOP3B2, TPST2, TRABD, TRIOBP, TRMU, TRNASTOPUCA, TRSPP1, TSPO, TSSK1A, TSSK2, TST, TTC28, TTC38, TTLL1, TTLL12, TTLL8, TUBA8, TUBGCP6, TUG1, TXN2, TXNRD2, TYMP, UBE2L3, UCRC, UFD1L, UNC84B, UNQ1945, UNQ6126, UPB1, UPK3A, UQCRFSL1, USP18, USP41, VCF, VN1R9P, VPREB1, VPREB3, VWFP, WBP2NL, WNT7B, XBP1, XKR3, XPNPEP3, XRCC6, YDJC, YESP, YME1L2, YPEL1, YWHAH, YWHAQP2, ZBED4, ZC3H7B,

Un particolare gene di questo cromosoma

```
GenomeData["C22CTA250D109"]
```

```
ATGGCGCGGGCCGGGGCGCGGGGACTGCTCGGCGGCCGCCGTCCTCCCGGCCTCCGGCTCGCGCTCGCGCTTCGGCTCGCGTT
    GCTGCTGGCGCGGCCGCCGTCGGGCCGCGCGGGAGCCCCCGAGGCGCAGGGTCCCGCGGCGCCCGGCACGACAGCCCC
    GGAGGGGGGCGACCGCTGCCGCGGCTACTACGACGTGATGGGCCAGTGGGACCCGCCCTTCAACTGCAGCTCCGGAGC
    CTACAGCTTCTGCTGCGGCACGTGCGGCTACCGCTTCTGCTGCCACGACGGGCCGCGGCGCCTCGACCAGAGCCGCTGTT
    CCAACTACGACACGCCGGCCTGGGTCCAGACAGGCCGGCCGCCCGCCCGCGCCCGCGACACCGCAGCGCCCCGGGACC
    CCGGCCGCGAGCGCAGCCATACGGCCGTCTACGCTGTGTGCGGCGTCGCAGCGCTGCTGGTGCTGGCCGGCATCGGGGC
    GCGCCTGGGACTGGAGAGGGCGCACAGCCCGCGCGCGCGGCGCACAGTGACCAGGTGAGCACGCGCCGCCCAGGGACC
    CCCGCCTGCTCCTCGGACTGCTCTCCCTGCCCGCTGATCCTTCCCGCCGCTCTCGAAGCGCTGGTTCTCCCAGCAGGCCCC
    TTCTCTGGGTTTTCCTGTCTCCTTCTCCCCCCGCCGCCCCCCCAACACTTCATCAGGGAGACACCTGACACCGCCCTGACT
    CCCTTTGACCTTCTGCCCGTGCTGGGCGCCGCACCGCCTTTCCCTGCTCGAGTCTCCTCTGGAGGGCAGGGGGGTGGGGG
    CGGGCTGGGAGGGGGACAGGTAGCCTTGCACAGAGGGCACCGGGTCACTGTCCAGGGTAAGGGGCGCCGCTGGCCAGG
    GAGGTGACCGGGCGTCTTGGGCACGGGAAAGGAAGGGGCGCTTGGTTCTCTGGGTGCCCATCTCCTGCTTCTCCCCACT
    CCTCCCTCCCCTCTTCCACCTCCTGCCTCTCCCCTGCCCCCACAGCTGTGACTCAAGGCTGCCCTTCCCTCCTTGGGTTTC
    AAAGGCCTCCCCCCCACTCACCCCATGCCACAGCTCCCAGGTGAAGGTCAGGGCTCCCTCTGCGTAGAAAGGGGACTCTG
    GAACACAGTCGTGTGTTGCTGAGGCCAGGACAGGTGCTTGTTGCATTCTGAGCTTGGTGTGAAGTGGGCACTACAGGGT
    CCAGGTCCCCTTCCTCGGTTGGAACGAGGACTCTAGGACTCTATGTGTCCTGACCCTGGAACTCCCACCCACATGCCACA
    CGTGGCACTCACATGCCCCCAGCAACCCCCATGCCCTGGGGCCTGTGCCCTCCTCATCCACCCGGTCCCAGCACCCTTTG
    GGCCTGTGGGCTGCTGACACCGAATGTGACAGGCTGGTATTTAAAAGTGACCATAGAGAAGCCTTCATACCCTGGCAGG
    CCAGATGTGGACACTTCCCCCTCCTGGGCCTCAGAGGCAGGGGGTGAGGGCTTCCTTGGCACTTCAGCACCCCTCGCTCC
    CGAAACCACGTAGCCCACTTTCTCCCAGGGAGCTCTAAGGGAAGCCCGGGCTGGCACCCTGGCCTCCACCCTCAGCTTC
    TGCACTGCCTTCAGGAGGTGGAGCCTCCTGGCCTGGCTTCTGGATGCTGCAGGGGTAGGGGCTGGGCTGCCCAAATTTG
    GGGGTCCCCCATGATGGGTGAGGGTAGCTTGGAAGAGGCCTGGATATGTCTTTGACAGGGGCGGGGAAAAAGGAACTT
    AGGGCTGCGATGGTGAGGGGTGGCTGCAGCAGCCCAGCTGACATGTTCATCCTGAACTCCCTGCACCTGCTGGGGATGG
    GGCAGCAGGTTTGGTGATGCCGCAGGAAAGCCATGCCCACCCTTGCTGTGCTGTGTGGTGTAGGCCAGTCCCTTCTCCTT
    TCTGGGCTTCAGGCTCCCATGGCCCCAACTCCCTTTTCTCTGCTGGGGAGACCTGGAATGGGACGTAGGCTTGTGTGTGG
    GTGTGTCCTGAGTCCCTGTCCTCCCCTCGAGTCTCACCCTTCATTCTGCTGTGTTGGGGTTGAAGGCCAGGGAAGGCTTCT
    CAGAGGGCTTGGGCGGGGCATCTGGAAAGAGTTTGTGCAAAGGCCCAGAGGCGTGGTGGTTACTCAGCTGTCAGGGAG
    ACAGGAGCTTGAGGTGCTTGCCCAGAGATGAGGCCACAGAGGTGAGCCTCTGGGGAGAGGGCAGGGCAGGAAGGTCAG
    CCCAGGCAGGTACTAGGATGGTTTCAGACCCTGCCACCAAACCTGAAGCCAAACCTCGGCCATCCCTGGTGTCCTGCCT
    CCTGAATGACCTTCACGAATCAGCCATTTGAGGCTCTAGCCCCGGAAGGAGGGTCAGGCTGAGTGGGAGAAAATCATGG
```

GTTCCGGGTTCTGAAGGCAGCTGGGCTGCAGACACTGTCACATCACAGCTGGGTGGGGGCTGGGTGTTGGGTCCAAGGA
GGTGGCTGTCCAAGGTCACACAGCCTGTGGGTCCTGGGCTGCCACCAGGGGGTCTCCCAACATCCCCATTCCGTCACCC
ATCTGTCCTTCATGCCCGTGATGGCAGCTTTATCCCAGGTCCCAGCAGAAGCCGCGGCTGCAGGGGCAGTTAGGCAGGC
AGGTAAATAAGGCATCCTGGGCCGGGCGCGGTGGCTCACACCTGTCATCTCAGCACTTTGGGAGGCCGAGACCGGCGGA
GTTGGAGACCAGCCTGGCCAACATGGTGAAACCCCGTCTCTACTAAAAATACAAAAATTAGCTAGGTGTGGTGGCAGGC
ACCTTATAATCCCAGCTACTAGGGAAGCTGAGGCTGGAGAATCACTTGAACCGGGGAGGTGGAGGTTGCAGTGAGCCA
AGATTGCGCCATTGCACTCCAGCCTGGACAACAGAGCGAGACTCTGCTTCAAAAGATAAAAAAATTAAAAAAAAGGAT
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CCTCATTAGAGTTTCCTGACCTGCTCTGGGAAGCAGCTGTCTTGGGGCCACAGGTGAGGCTGGCAGATACTGCCTGGGA
GGGGAAACTCGTGCGTGATTTCGAGCACCGGAGAGGACGGCCTGGAGAGGCCGAAAGAACTGCCCAGGGCCACACGGT
GAGACGGTGGTGGCCGGGGCTGGCTTTTGATGAGGTGGGAGACAGAGGGCCACCCCTGACTGCTGTCCCCGCAGGGCG
CTGACAGAGCTTCTGAAGCAGCCGGGCCCCCAGGAGCCACTGCCTCCCACCCTGGGCCCACCCCTGGGTGGCTGTGTCC
AGGTGCAGATGGGGGACGGCCTCCCCCGGGGCTCCCCCCACAACAGCGCAGGTGAGTCGGTGGCGGGCGGGGCTGAGC
GGCGGCGGAGCACGCGGAGGGGCGTGAGAGGCCGAGAGGCGGTCCCTCGGCTGGGGCATAGAGGCTTCCCCGGTGGAA
ATGAGCCGCGGCCTCTGCGGGTGAGGGGCCCGACCGGCCAGCCAGCTCGCCAGGGTGGAAAGGGACCCCCCACGGGTC
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AGGCTCGGGCTCCAGAGCCTCCCCCTGGGTCTCTCGAGAGGCAGGCAGGCTTGGCAGCCCCCACGCCCCGTCTGGGTTC
TGTTCCTCAGACATCCCCCGTCTCGGCGGGAGCAGGTCCCAGGACTCCGCGCCTGGCTCGAGCGTCGCCTCCGGGCGAG
CCGTTCATGAGGGTGGCACCCCCCGGGCTGGCTGCCGCCGCCGCTGCGCGTGACTCGGAGCCAGGCCCTGTTCCAGGCG
CTGGAGGCTGCGGCGAAGACAGGCTTGGCTCGCAGCCTCGCCCGGAGAACGGTCCCCCAGGTTCTCACCGAACGGCCTC
GGGGAGAGGACTACGGAGAGGTGACAGCGAGGGCGGAGTGAACCGGGGCATCGGACCGAGCCGCGTCTCACTCCTCGC
TCCAGACAAGAAGCGCCTCAACAACGCGCCCCGGGGGTCGGCCGCCCCGGGGCCCCCGCGCGGCCCGCGGCTGCAGGG
CGGCGGCAGCCTGACGCTGCAGCCAGACTACGCCAAGTACGCCACGTTCAAGGCCGCCGCGCTCAAGGCCGCAGGTGA
GTGGCGGGTGCGGGCAGCGTCAGGGCACCTGGGCGCACGAGCTCCCGGACTGCGAAGCGCGGGGCCGCAGCTCCAAGC
GCCAAATTCCCAGTTCCGCGCGCCCGCCGCTCGGCCAATCGGCTCCCTCGCCCCAGCGGGCCCCGCCCCCGGCCCGCCCC
GGCCCGGTCCCCGTCCCAGTCCCCGGCCGGGACCCCTTGTCCAGTCCTGAGCTTGGGTGCTCGGCGCGGCGTCACTCTTC
CCTGCCCTGTCCCCGCAGAGGCCGCCCCGCGGGACTTCTGTCAGCGTTTCCCCGCCCTCGAGCCGTCCCCGCGGCAACCC
CCGGCGCGGGCTCCGCGACCATCCCCGGACTTGCCTGCGCCGCTGGACGCCTGCCCCTGGGCCCCGCCGGTCTACGCGC
CCCCTGCCGCGCCGGGCCCCTATGCCGCCTGGACCTCCAGTCGCCCGGCCCGGCCCGCCCCGCTCAGCCACCCGACGGC
TCGGGCCTTCCAGGTACCCCGGCGACCCGGGCACGCGGCCCGGCGCCAGTTCAGTGTGAAGATGCCTGAGACCTTCAAC
CCGCAGCTCCCCGGCCTTTACGGCAGCGCGGGCCGCGGGTCCCGGTACCTAAGGACCAATAGCAAGACCGAGGTCACCG
TGTGA

```
GenomeData["C22CTA250D109", "SequenceLength"]
```

4903

Trovare i 15 geni più corti nel genoma umano

```
Take[Sort[{GenomeData[#, "SequenceLength"], #} & /@ GenomeData[]], 15]
```

11	IGHD727
16	IGHD411
16	IGHD417
16	IGHD44
17	IGHD11
17	IGHD114
17	IGHD120
17	IGHD17
18	IGHD66
19	IGHD423
20	IGHD126
20	IGHD518
20	IGHD524
20	IGHD55
21	IGHD613

`GenomeLookup` permette di trovare la posizione di sequenze di DNA nel genoma umano:

```
GenomeLookup["CTCTCTAACTAAACT"] // TableForm
```

Chromosome1	108 939 073
1	108 939 087
Chromosome1	138 309 610
– 1	138 309 624
Chromosome5	139 640 264
– 1	139 640 278
Chromosome8	72 019 948
1	72 019 962
Chromosome9	110 092 060
1	110 092 074

```
GenomeLookup["CTCTCTAACTAAACT", "Count"]
```

5

» AstronomicalData

La densità dei pianeti

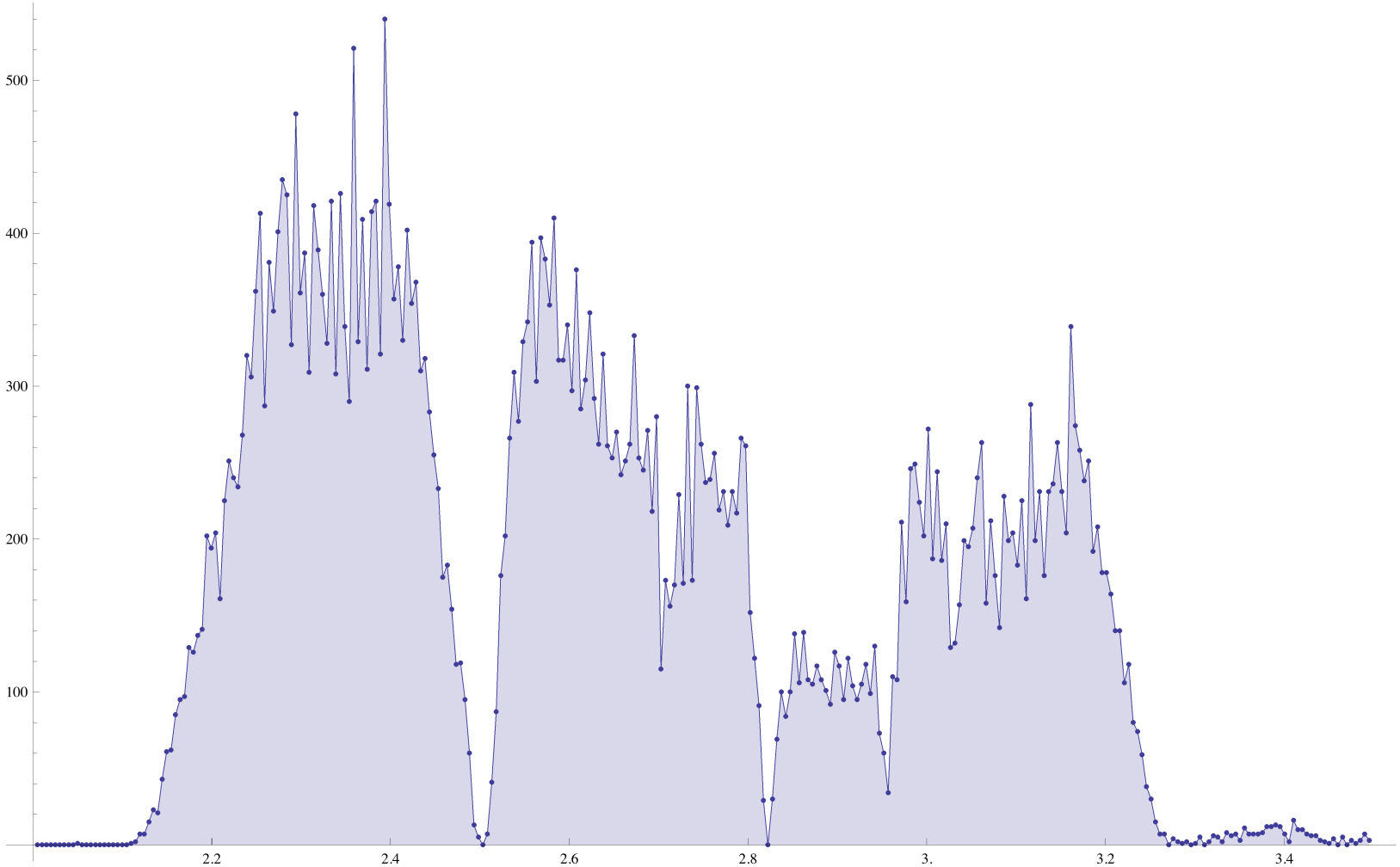
```
Text[Grid[{AstronomicalData[#, "Name"], AstronomicalData[#, "Density"]} & /@
    AstronomicalData["Planet"], Frame → All, Background → LightYellow]]
```

Mercury	5427.
Venus	5243.
Earth	5515.
Mars	3934.0
Jupiter	1326.2
Saturn	687.1
Uranus	1270.
Neptune	1638.

Computa e visualizza la distribuzione dei pianeti minori a varie distanze dal sole:

```
asteroidCount = BinCounts[Sort@Cases[(AstronomicalData[#, "SemimajorAxis"] / 149 597 870 691) & /@
      Join[AstronomicalData["InnerMainBeltAsteroid"], AstronomicalData["MainBeltAsteroid"],
       AstronomicalData["OuterMainBeltAsteroid"]], x_?NumberQ], {2, 3.5, .005}];
```

```
ListPlot[asteroidCount, Joined → True, Filling → 0, Mesh → All,
 Ticks → {Table[{Rescale[x, {2, 3.5}, {0, 301}], x}, {x, 2, 3.5, .2}], Automatic}]
```



» CountryData

I 20 paesi più grandi per estensione del territorio

```
Last /@ Take[Reverse[Sort[{CountryData[#, "Area"], #} & /@ CountryData[]]], 20]
```

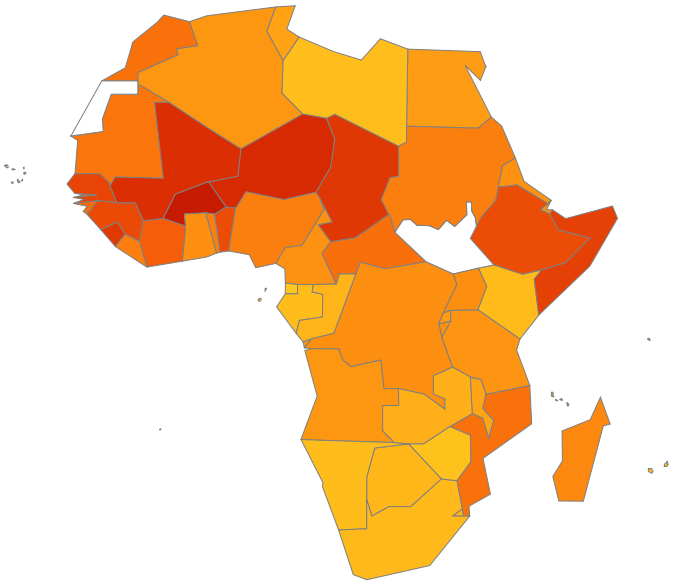
{Russia, Canada, UnitedStates, China, Brazil, Australia, India, Argentina, Kazakhstan, Algeria, DemocraticRepublicCongo, Greenland, Mexico, SaudiArabia, Indonesia, Sudan, Libya, Iran, Mongolia, Peru}

```
Text[Grid[Prepend[
    {CountryData[#, "Name"], CountryData[#, "Area"], CountryData[#, "Population"]} & /@ Take[%, 5],
    {"", "area", "population"}], Frame → All, Background → {None, {LightBlue, {LightYellow}}}]]
```

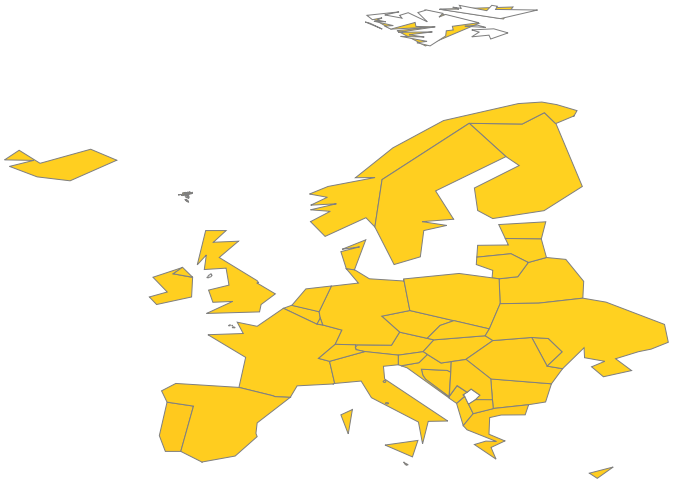
	area	population
Russia	1.70752×10^7	1.42558×10^8
Canada	9.98467×10^6	3.49937×10^7
United States	9.63142×10^6	3.1933×10^8
China	9.59696×10^6	1.35937×10^9
Brazil	8.51488×10^6	2.0005×10^8

Tasso di alfabetizzazione in alcuni continenti (Africa, Europa e Asia):

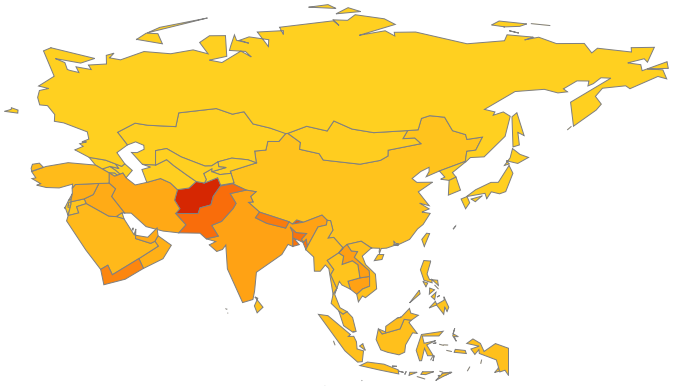
```
Graphics[{EdgeForm[Gray],
    Catch[ColorData["Warm"][CountryData[#, "LiteracyFraction"] /. _Missing :→ Throw[White]]],
    CountryData[#, "SchematicPolygon"]} & /@ CountryData["Africa"]]
```



```
Graphics[{EdgeForm[Gray],
    Catch[ColorData["Warm"][CountryData[#, "LiteracyFraction"] /. _Missing :> Throw[White]]],
    CountryData[#, "SchematicPolygon"]} & /@ CountryData["Europe"]]
```

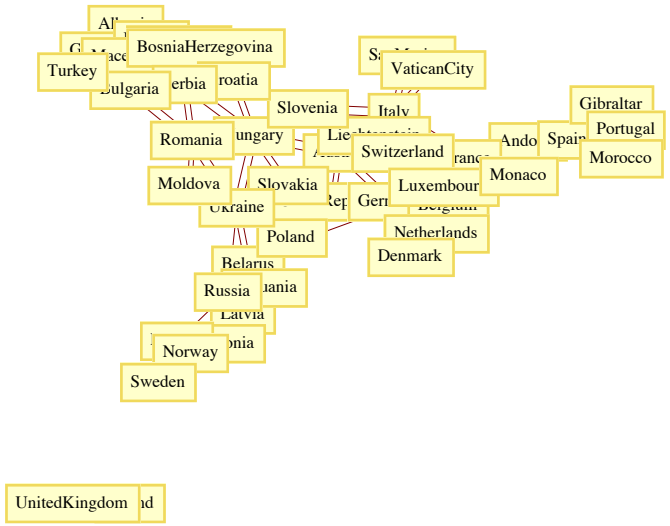


```
Graphics[{EdgeForm[Gray],
    Catch[ColorData["Warm"][CountryData[#, "LiteracyFraction"] /. _Missing :> Throw[White]]],
    CountryData[#, "SchematicPolygon"]} & /@ CountryData["Asia"]]
```



Il grafico dei paesi confinanti in Europa:

```
GraphPlot[Flatten[Thread[# -> CountryData[#, "BorderingCountries"]] & /@ CountryData["Europe"]],
 VertexLabeling → True]
```



Una mappa con i nomi di tutte le nazioni:

```
Graphics[{LightGreen, EdgeForm[Gray], Tooltip[CountryData[#, "Polygon"], #] & /@ CountryData[]}]
```

» Alcuni dettagli tecnici.

Quando si installa *Mathematica* i contenuti della sorgenti “data collection” non vengono installati ma quando li si utilizza esplicitamente i dati vengono salvati in memoria locale per le eventuali computazioni successive (non l’intero database ma solo i dati esplicitamente richiesti). Per sapere dove si trovano questi file:

```
SystemOpen[FileNameJoin[{$UserBaseDirectory, "Paclets"}]]
```

In alcuni casi potrebbe succedere che i dati in cache sul proprio computer vengono danneggiati. In tali casi si può ricostruire l’archivio già presente nella propria cache:

```
RebuildPacletData[]
```

Se si vuole lavorare solo sui dati già in memoria cache si può disattivare l'aggiornamento automatico (ad esempio, se si sono ca
cati dei dati in memoria e poi si viaggia senza avere più accesso alla rete):

```
PacletManager`$AllowDataUpdates = False
```

Conclusioni: gli scenari analizzati

» *Mathematica* come strumento stand-alone con i dati forniti internamente o importati/esportati da codice.

» *Mathematica* integato con altri ambienti e sistemi con i possibili collegamenti creati grazie alla modularit dell'architettura front end / kernel.