

Mathematica Overview

Freshman Seminar

2016, Kenneth Levasseur
Mathematical Sciences
UMass Lowell
Kenneth_Levasseur@uml.edu

The Basic Input/Output Process in *Mathematica*

From Simple Math...

```
Expand[(x + 2 y)^5]
```

... to many other things

```
WeatherData[$Aborted, "Temperature"]
```

```
Math Dept Twitter: @UMassLowellMath
```

```
s = "Temperature in Lowell right now is " <> ToString[
```

```
WeatherData[Lowell (city) , "Temperature"]] <> " #LowellWeather #MathSciences";
```

```
StringLength[  
s]
```

```
SendMessage["Twitter", "Temperature in Lowell right now is " <> ToString[
```

```
WeatherData[Lowell (city) , "Temperature"]] <> " #LowellWeather #MathSciences"]
```

```
ServiceExecute::apierr: The service returned the following error message: {{message -> Status is a duplicate., code -> 187}}. >>
```

Types of Input

Free-Form Input

```
Factor[12 383 975 934 753]
```

```
FactorInteger[12 383 975 934 753]
```

Integrate $[x^2 * \sin[x], x]$ ✓

PrimeOmega [12 383 975 934 753]

acetone (chemical) [boiling point] ... ✓

Wolfram Language Input

Wolfram Alpha Input

 Boiling Point of acetone


Algebra/Calculus

Factor $[3x^2 - 13x + 10]$

Solve $[3x^2 - 13x + 10 == 0, x]$

Solve $[x^{2^x} == \cos[x], x]$

Solve::nsmet: This system cannot be solved with the methods available to Solve. >>

Plot cos(x) from -3 to 3 
 Plot[Cos[x], {x, -3, 3}]

Plot[{ x^{2^x} , Cos[x]}, {x, -3, 3}]

Plot[{ $x^{2^x} - \cos[x]$ }, {x, -3, 3}]

FindRoot [$x^{2^x} == \cos[x]$, {x, 1}]

FindRoot [$x^{2^x} == \cos[x]$, {x, -3}]

$y = x \sin[2x + 1]$

D[y, x]

Integrate[y, x]

Integrate[y, {x, 0, Pi}]

$y = (ax + b) / (cx + d)$

Manipulate[Plot[($ax + b$) / ($cx + d$), {x, -2, 2}],
 {a, 0, 2}, {b, -2, 2}, {c, -2, 2}, {d, -2, 2}]

```

a = 0.7;
b = y /. {x -> a};
m = D[y, x] /. {x -> a};
Plot[{y, m (x - a) + b}, {x, -Pi, Pi}]

Clear[a]
Manipulate[b = y /. {x -> a};
  m = D[y, x] /. {x -> a};
  Plot[{y, m (x - a) + b}, {x, -Pi, Pi}, PlotRange -> {-5, 5}], {a, -Pi, Pi}]

D[f[x]^2, x]

Sin[a x + d]

Manipulate[Plot[Sin[d + a x], {x, -7.28319, 5.28319}], {a, -7.28319, 5.28319}, {d, -2, 2}]

```

Differential Equations

```
DSolve[{w'[t] == w[t] - 1, w[0] == 3}, w[t], t]
```

Probability & Statistics, Modeling

```
Probability[heads == 2, heads ~ BinomialDistribution[10, 0.5]]
```

If off line, the intended data is listed below.

```
temps = Import["http://faculty.uml.edu/klevasseur/Data/Tdata.csv"]
```

```
Mean[temps[[All, 2]]]
```

```
ListPlot[temps]
```

```
bestline = Fit[temps, {1, t}, t]
```

```
Show[{ListPlot[temps], Plot[bestline, {t, 0, 15}]}]
```

```
Clear[a, b];
```

```
expofit = NonlinearModelFit[temps, {a ebt}, {a, b}, {t}] // Normal
```

```
Show[{ListPlot[temps], Plot[expofit, {t, 0, 15}]}]
```

Numbers

```
1000!
```

```
FactorInteger[1000!]
```

```
Is 74274943 a prime?
```

```

Is 74274943 a prime?
PrimeQ[74 274 943]

```

```
Prime[1 000 000]
```

```
N[Pi, 1000]
```

Graphics

Enrollment in Calculus I one semester, by level

```
calcOne = {"Freshman", 308}, {"Sophomore", 85}, {"Junior", 24}, {"Senior", 12}
```

```
PieChart[calcOne[[All, 2]], ChartLabels -> calcOne[[All, 1]]]
```

```
ContourPlot[Cos[x] + Cos[y], {x, 0, 4 Pi}, {y, 0, 4 Pi}]
```

```
Plot3D[Cos[x] + Cos[y], {x, 0, 4 Pi}, {y, 0, 4 Pi}]
```

```
Plot3D[x^2 - 2 y^2, {x, -2, 2}, {y, -2, 2}]
```

```
Plot[(x + 1)^2, {x, -2, 2}]
```

```
pic = Import[
  "https://c.00bg.com/rf/image_960w/Boston/2011-2020/2015/11/17/BostonGlobe.com/Sports/
  Images/Tlumacki_soxvsroyals432.jpg"]
```

```
pic2 = EdgeDetect[pic]
```

```
d = DominantColors[pic2]
```

```
ColorReplace[pic2, {d[[1]] -> LightBlue, d[[2]] -> Red}]
```

```
z = 2 + 5 I
```

```
Abs[z]
```

```
arg[z]
```

Questions?

Not covered:

99% of *Mathematica*, including the programming language, data bases, and many other mathematical/scientific topics.

```
KnotData["Stevedore"]
```

```
PolyhedronData["Dodecahedron"]
```

ChemicalData [acetone (chemical) , "BoilingPoint"]

CityData [Lowell (city) , "Population"]

DateListPlot [

FinancialData [Apple (financial entity) , {{1990, 1}, {2015, 8}}, PlotRange → All]

PersonData [Tom Brady (person) , "Weight"]

? *Data

▼ System`

AdministrativeDivisionData	GalaxyData	PIDData
AircraftData	GenomeData	PlaneCurveData
AirportData	GeodesyData	PlanetaryMoonData
AirPressureData	GeoElevationData	PlanetData
AirTemperatureData	GeologicalPeriodData	PlantData
AlgebraicRulesData	GeoProjectionData	PolyhedronData
AstronomicalData	GraphData	ProteinData
BoxData	GraphElementData	PulsarData
BridgeData	GraphicsData	RawData
BroadcastStationData	HistoricalPeriodData	SatelliteData
BuildingData	HTMLData	ScheduledTaskData
ButtonData	HTTPRequestData	SeriesData
CalendarData	HypothesisTestData	SocialMediaData
CellGroupData	IconData	SolarSystemFeatureData
ChartElementData	ImageData	SolidData
ChemicalData	IslandData	SpaceCurveData
CityData	IsotopeData	SpeciesData
CloudAccountData	KnotData	StandardAtmosphereData
CloudLoggingData	LakeData	StarClusterData
CloudObjectInformationData	LaminaData	StarData
ColorData	LanguageData	StyleData
ColorProfileData	LatticeData	SupernovaData
CometData	LiftingFilterData	SurfaceData
CompanyData	LinearizingTransformationData	SystemInformationData
CompressedData	MannedSpaceMissionData	TemporalData
ConstellationData	MedicalTestData	TextData

ContinuousWaveletData	MeteorShowerData	ThermodynamicData
ControllerInformationData	MineralData	TropicalStormData
CoordinateChartData	MinorPlanetData	TunnelData
CoordinateTransformData	MountainData	UnderseaFeatureData
CountryData	MovieData	UniversityData
DamData	NebulaData	ValuesData
DeepSpaceProbeData	NeighborhoodData	VectorGlyphData
DiscreteWaveletData	NuclearExplosionData	VirtualGroupData
EarthImpactData	NuclearReactorData	VolcanoData
EarthquakeData	OceanData	WeatherData
ElementData	OLEDData	WeightedData
EvaluationData	OptimumFlowData	WindDirectionData
EventData	OutputFormData	WindSpeedData
ExampleData	ParkData	WindVectorData
ExoplanetData	ParticleAcceleratorData	WordData
FinancialData	ParticleData	ZIPCodeData
FiniteGroupData	PersonData	
FormulaData	PhysicalSystemData	

▼ PacletManager`

RebuildPacletData

UniversityData["name", "property"] gives the value of the specified property for the university "name".
 UniversityData[{name₁, name₂, ...}, "property"] gives a list of property values for the specified university names.
 UniversityData["name", "property", annotation] gives the specified *annotation* associated with the property. >>

Data