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How Can R Enhance Analytics on PI System Data?

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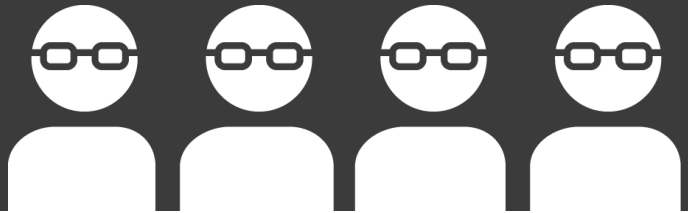
What Is R?

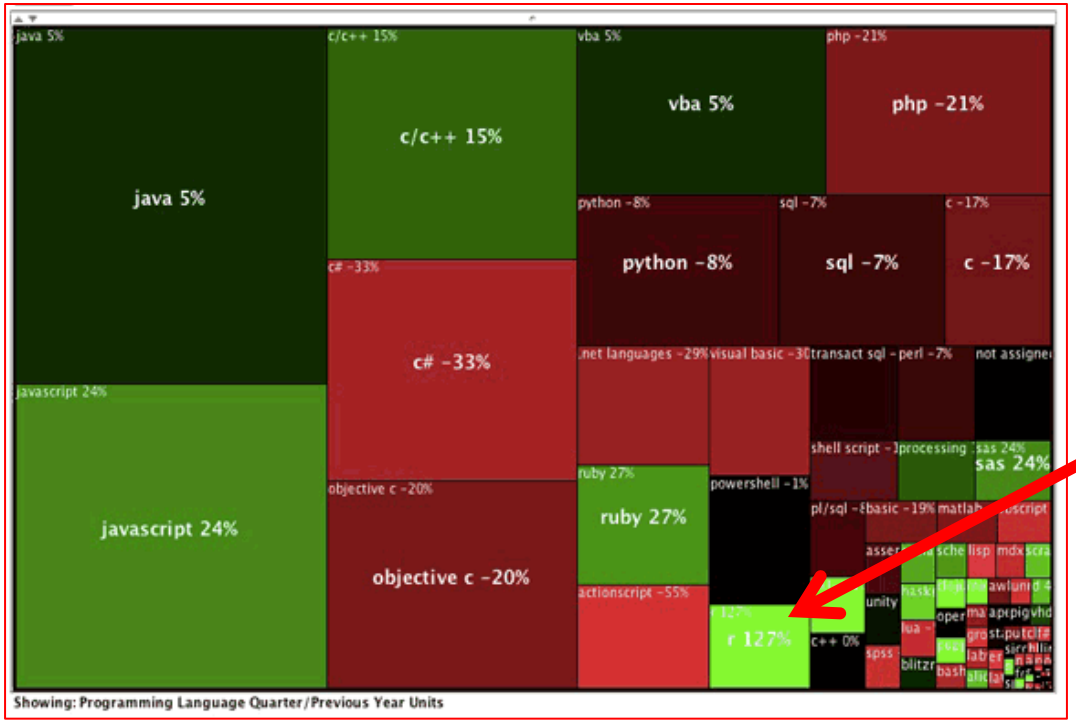


The R Project for Statistical Computing

- R-project.org: ***R is a free software environment for statistical computing and graphics. It compiles and runs on a wide variety of UNIX platforms, Windows and MacOS.***

  - Effective data handling
  - A suite of operators for arrays and matrices
  - Graphical facilities for data analysis and display
  - A well-developed, simple and effective programming language

R Popularity



Books sold
2011 over 2010

Source: Revolution Analytics

R Adoption

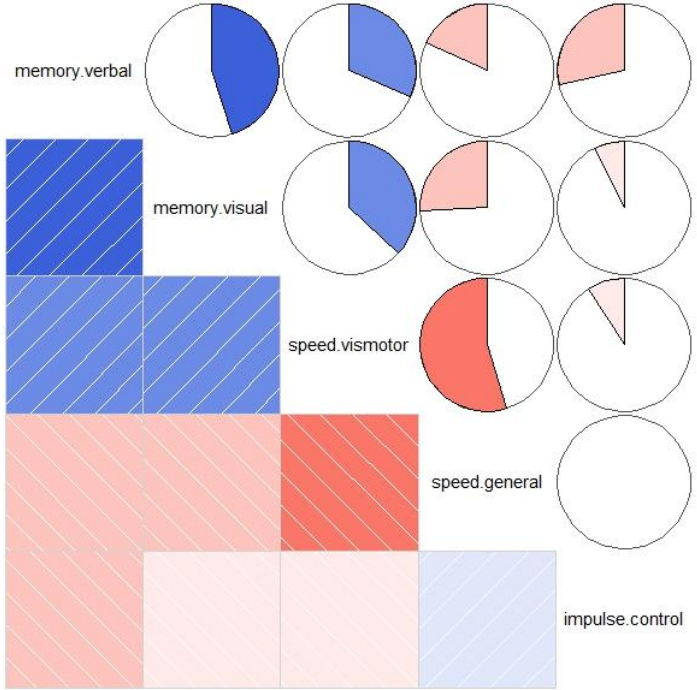
- Among top 5 open source platforms for Big Data (TechCrunch)
- Statistics and data science schools
- Big companies for R&D
- Commercial version in production
- Revolution Analytics

What Can R Do Best?

- Number Crunching
- **Statistical Analysis**
- Data Binning
- Regression Analysis
- Correlation Analysis
- Machine Learning
- **Great Visuals!**

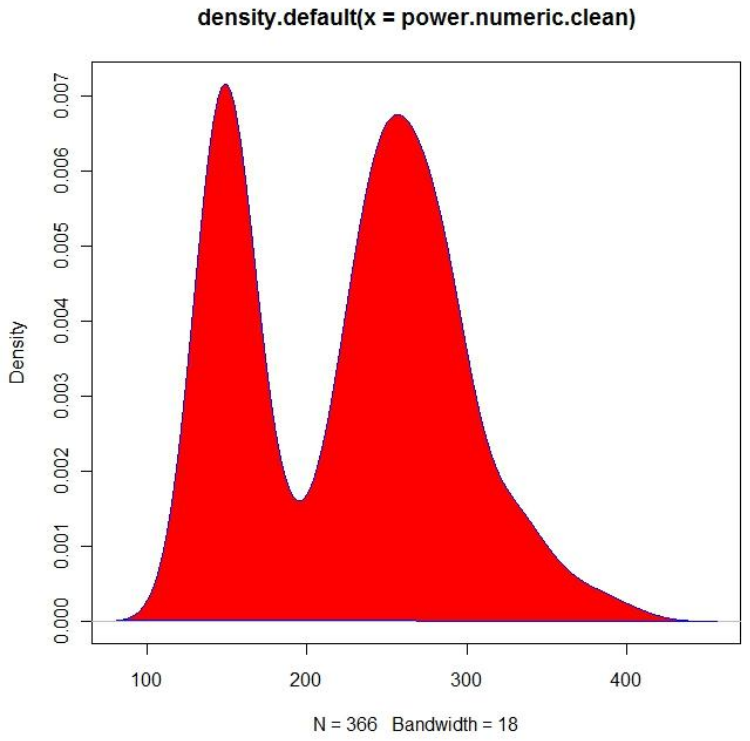
Example - Correlogram

- Correlation in an effective visual way



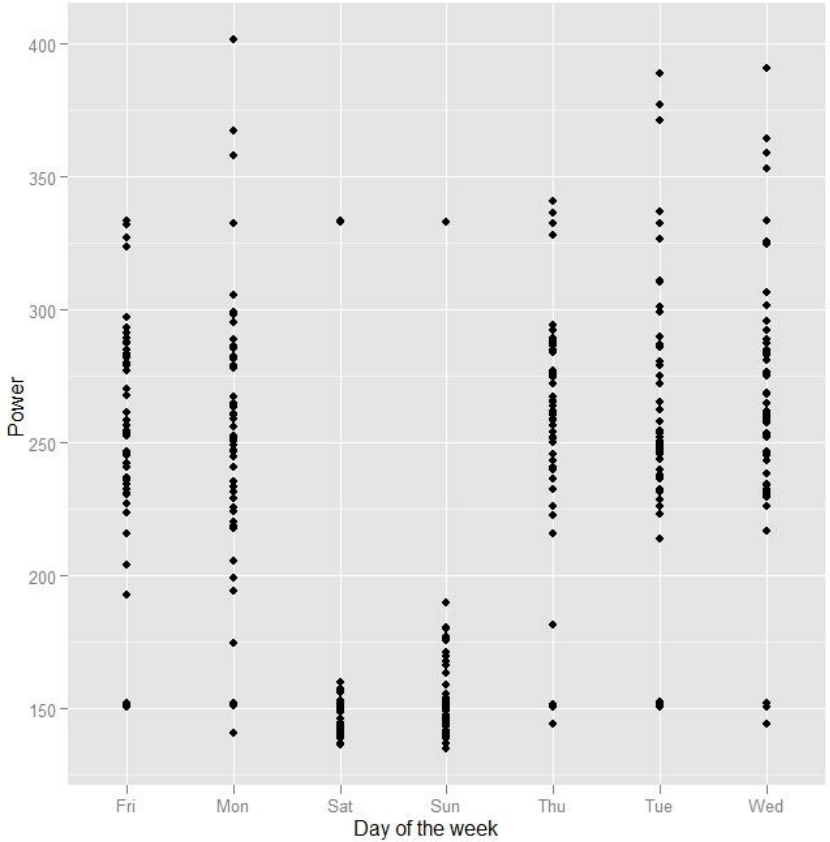
Example - Distribution

- Distribution analysis



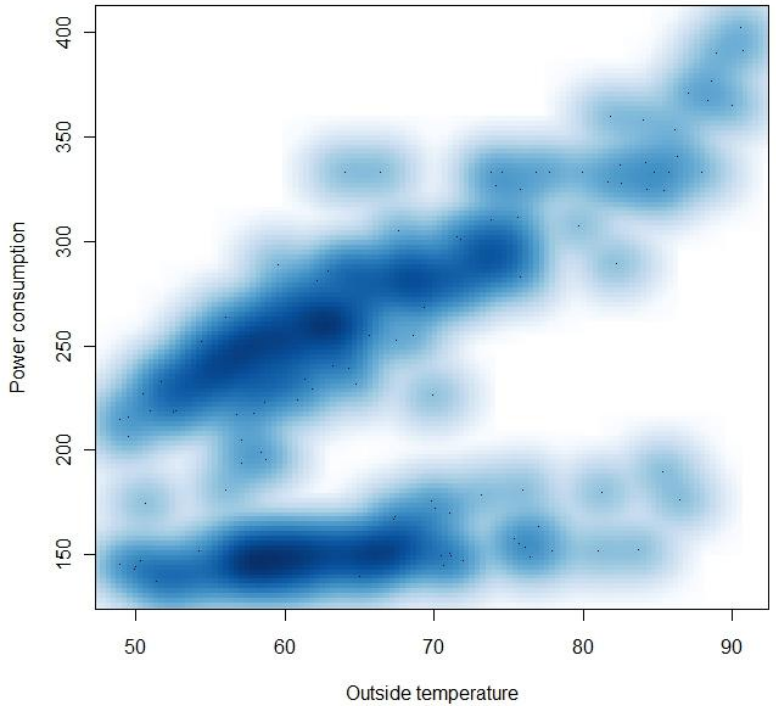
Example - Binning

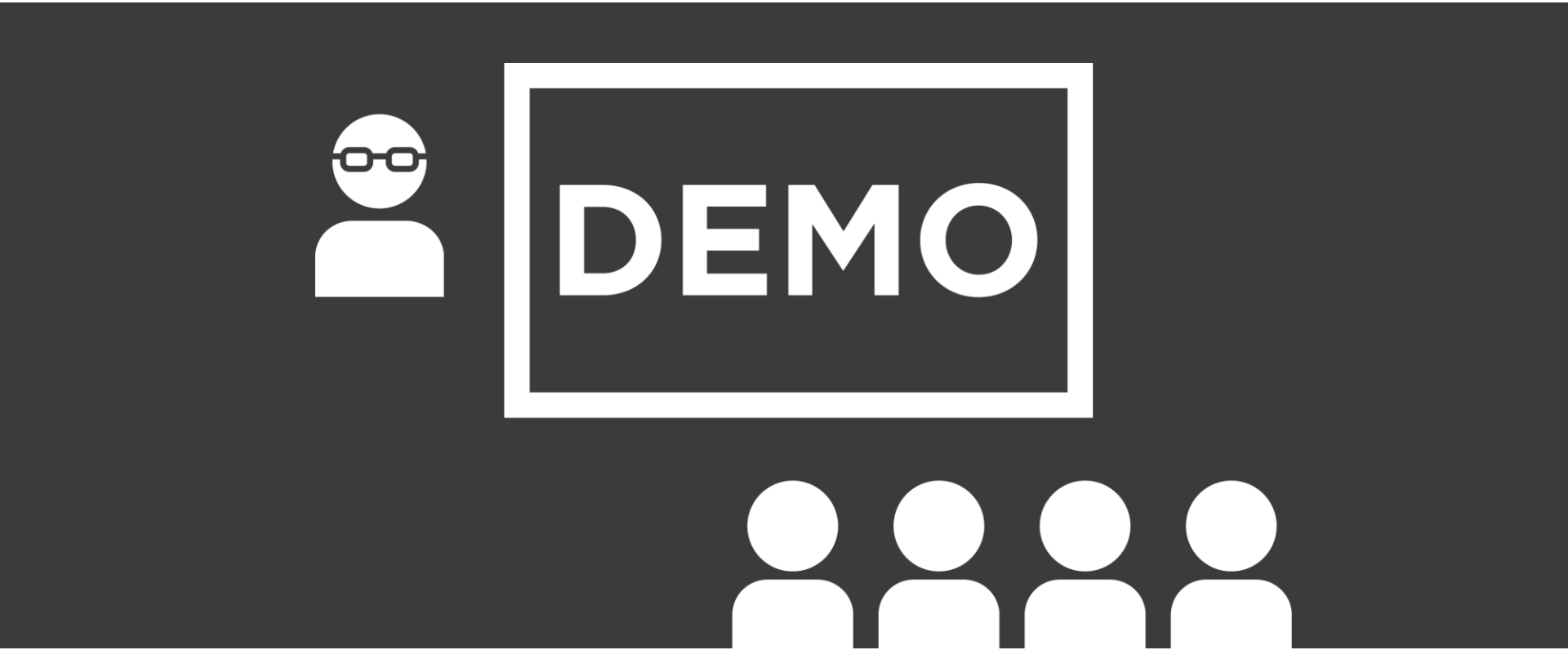
- Binning data into categories



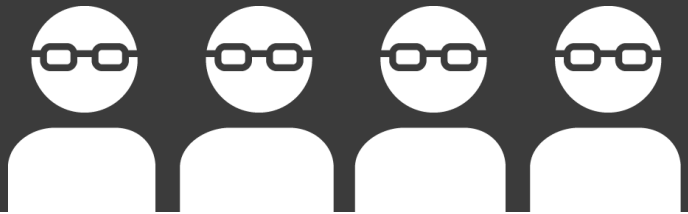
Example - Correlation

- Descriptive Statistics: Correlation





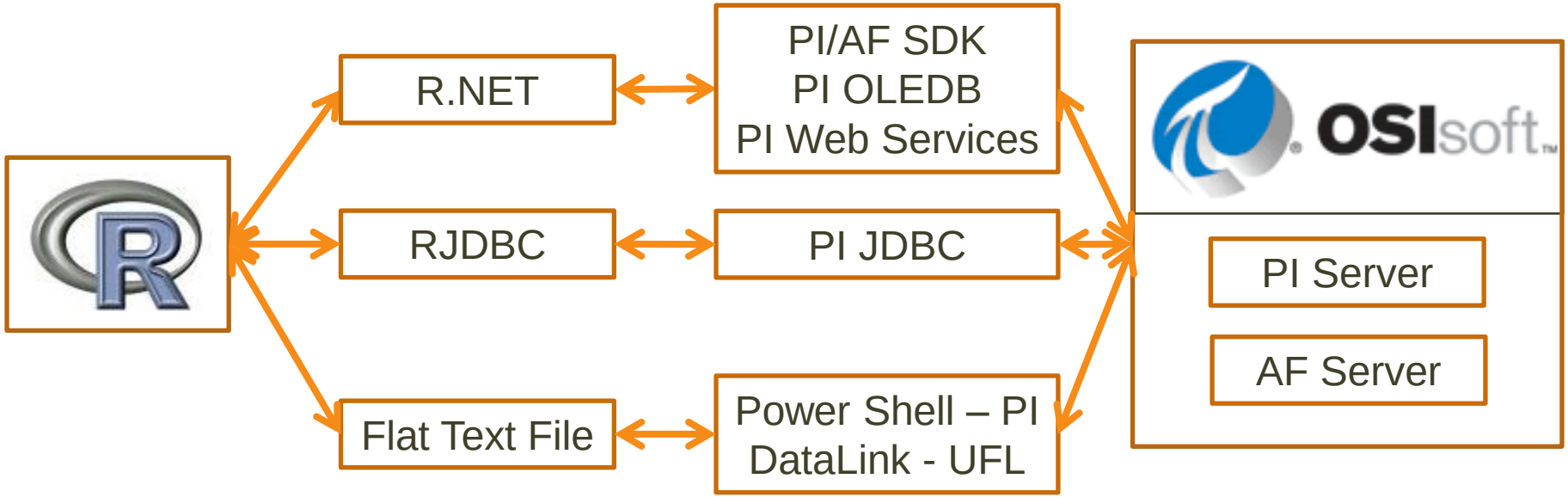
Why Integrating With the PI System?



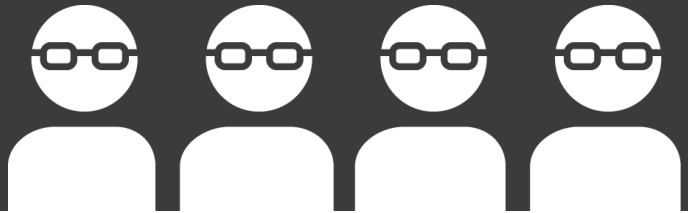
Perfect Synergy

- PI System is the Enterprise Data Infrastructure
- R can make sense of lots of data
- PI System Data Access allows efficient integration – Results can be put back
- R can be hooked to Hadoop and other unstructured databases (RHadoop)

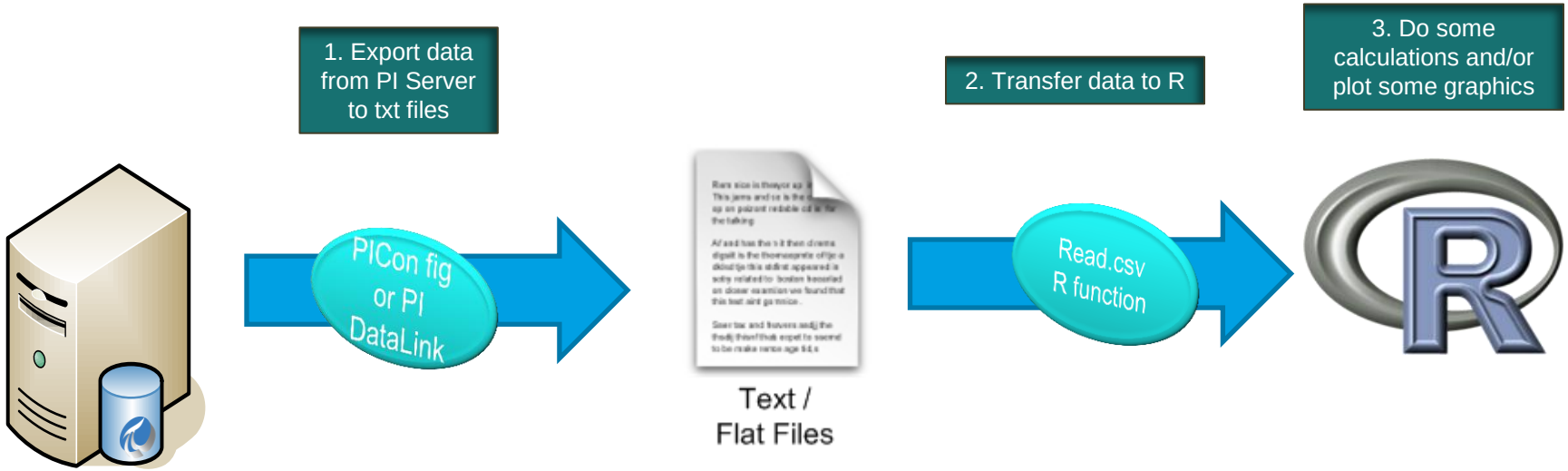
Possible Architectures



Integration with the PI System and Examples



Transferring Data Through Files




```
PowerTemp.df <- read.csv(file='C:\\Data\\SL - Power - Temp - 1year - Cleaned.csv', header=TRUE)
```

How to install R.NET?

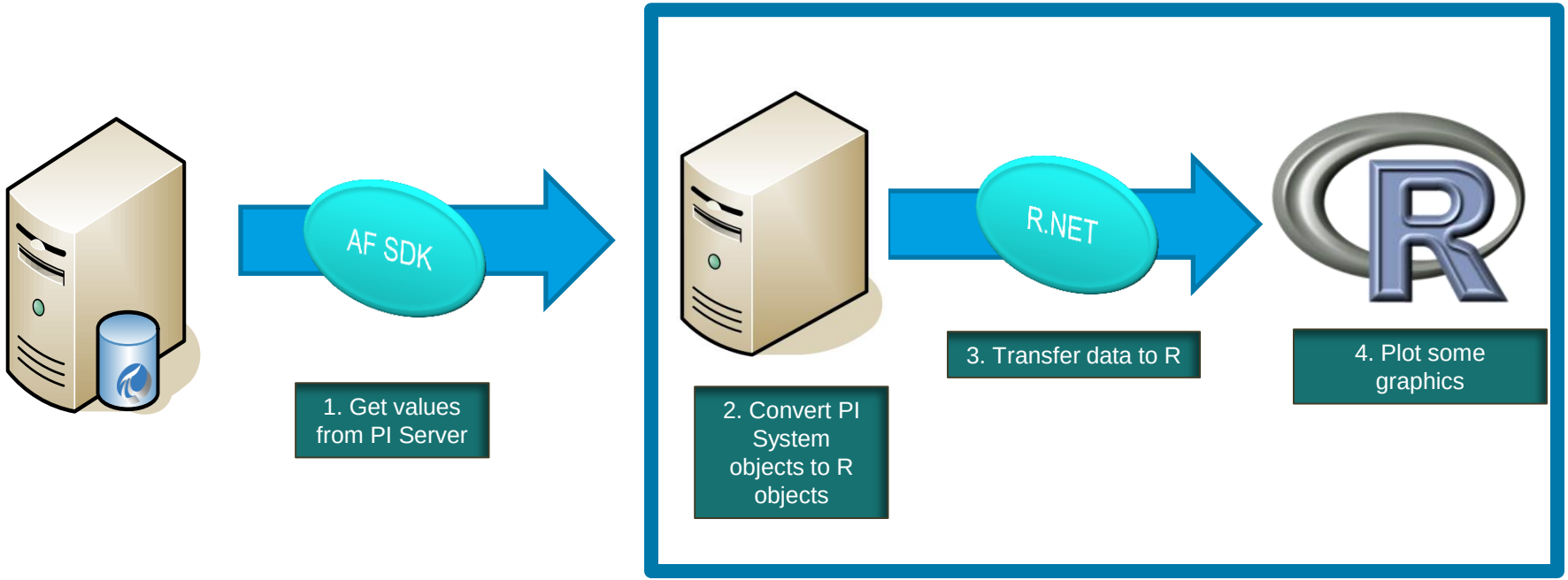
- Version 1.4
  - ❑ Download from: http://rdotnet.codeplex.com
  - ❑ Many known issues detected
- Version 1.5
  - ❑ Available in NuGet Gallery
  - ❑ Requires Package Manager Console.

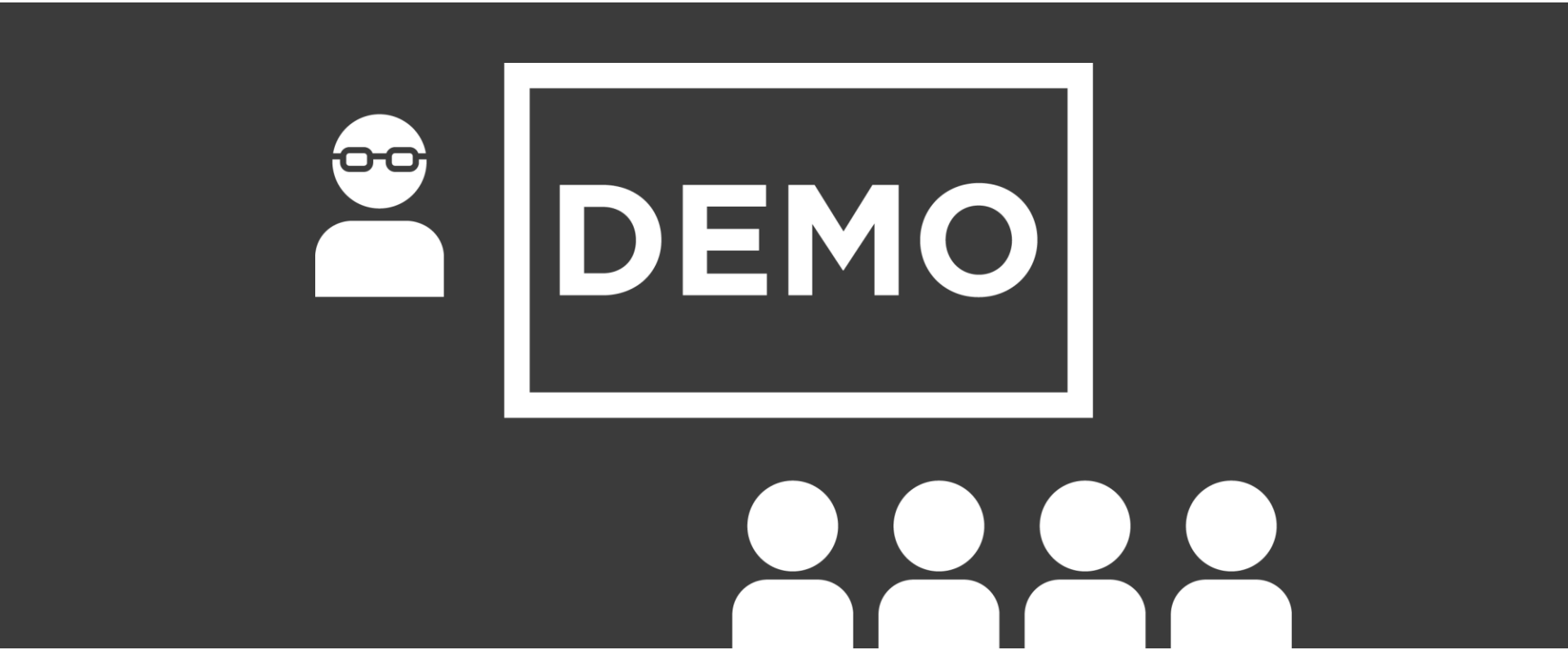
Classes in R.NET

R	R.NET	.NET Framework
character vector	RDotNet.CharacterVector	System.String[]
integer vector	RDotNet.IntegerVector	System.Int32[]
real vector	RDotNet.NumericVector	System.Double[]
complex vector	RDotNet.ComplexVector	System.Numerics.Complex[]
raw vector	RDotNet.RawVector	System.Byte[]
logical vector	RDotNet.LogicalVector	System.Boolean[]
character matrix	RDotNet.CharacterMatrix	System.String[,]
integer matrix	RDotNet.IntegerMatrix	System.Int32[,]
real matrix	RDotNet.NumericMatrix	System.Double[,]
complex matrix	RDotNet.ComplexMatrix	System.Numerics.Complex[,]
raw matrix	RDotNet.RawMatrix	System.Byte[,]
logical matrix	RDotNet.LogicalMatrix	System.Boolean[,]
list	RDotNet.GenericVector	
data frame	RDotNet.GenericVector	
data frame	RDotNet.DataFrame	
function	RDotNet.Function	

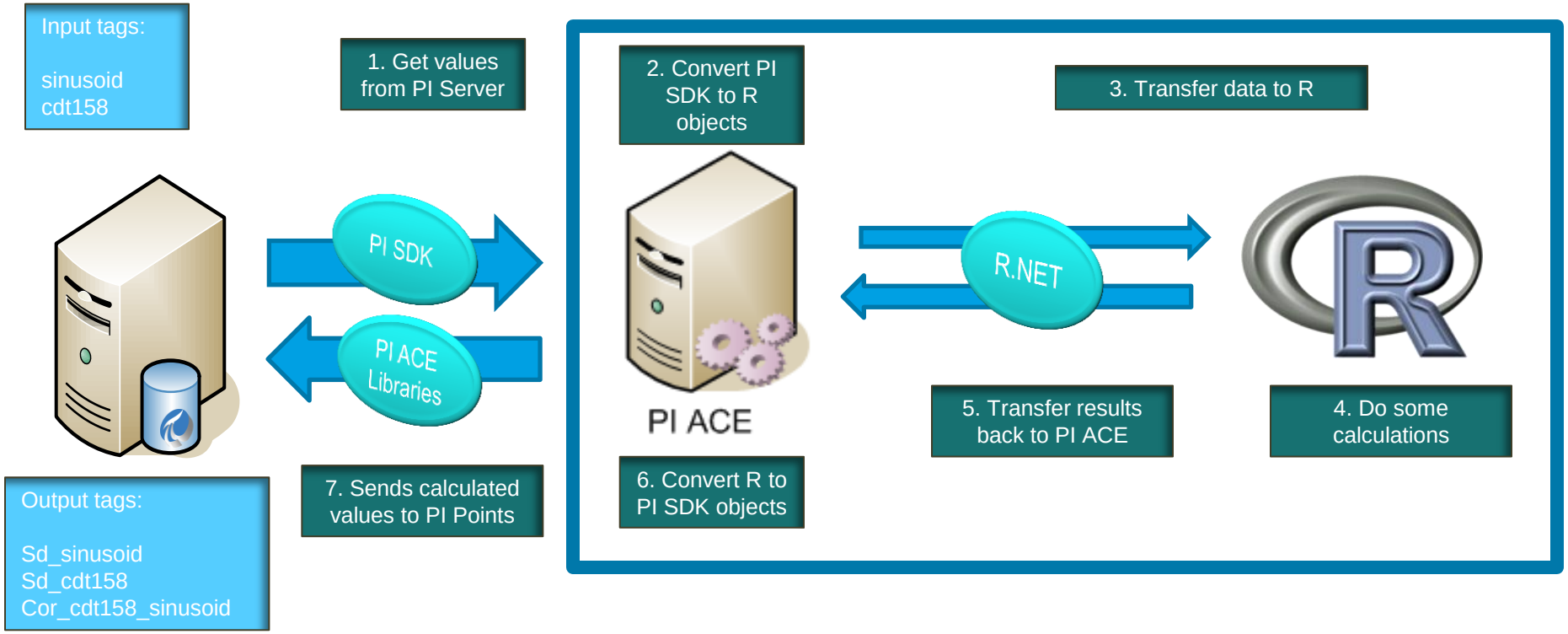
```
NumericVector NumVec = engine.Evaluate("1:20 + 0.4354").AsNumeric();
double[] double_array = engine.Evaluate("1:20 + 0.4354").AsNumeric().AsArray();
```

Windows Application





PI ACE Project



Using R.NET

- Initialization

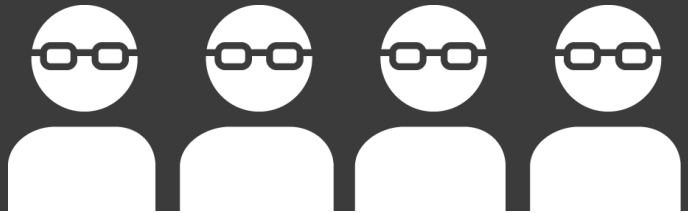
```
Dim engine As REngine = REngine.CreateInstance("RDotNet")
engine.Initialize()
```

- Converting objects

```
Dim sinusoid_val As NumericVector = engine.CreateNumericVector(sinusoid_ArrayValues)
Dim cdt160_val As NumericVector = engine.CreateNumericVector(cdt160_ArrayValues)
engine.SetSymbol("cdt160_val", cdt160_val)
engine.SetSymbol("sinusoid_val", sinusoid_val)
```

```
Dim Cor As NumericVector = engine.Evaluate("cor<-cor(sinusoid_val, cdt160_val)").AsNumeric()
Dim Sd_cdt160 As NumericVector = engine.Evaluate("sd_cdt160<-sd(cdt160_val)").AsNumeric()
Dim Sd_sinusoid As NumericVector = engine.Evaluate("sd_sinusoid<-sd(sinusoid_val)").AsNumeric()
```

Concluding Remarks



What to Take Home?

- R is a powerful programming environment
- R can do statistics and visuals
- R is free
- PI System handles all enterprise data
- PI System and R are good matches to marry!
- The marriage can be very fruitful

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THANK YOU