The World of Node.js

on IBM i

Presented by

Scott Klement

http://www.profoundlogic.com

To understand recursion
one must first understand recursion

The Agenda

Agenda for this session:

1. Node.js introduction
   - what it is
   - how popular it is
   - philosophy
2. Node.js basics
   - How it works
   - Hello World
3. Node.js Ecosystem
   - Node Package Manager (npm)
   - Demonstrations
     - Express
     - Debugging
     - E-mail
     - Spreadsheet

What is Node.js

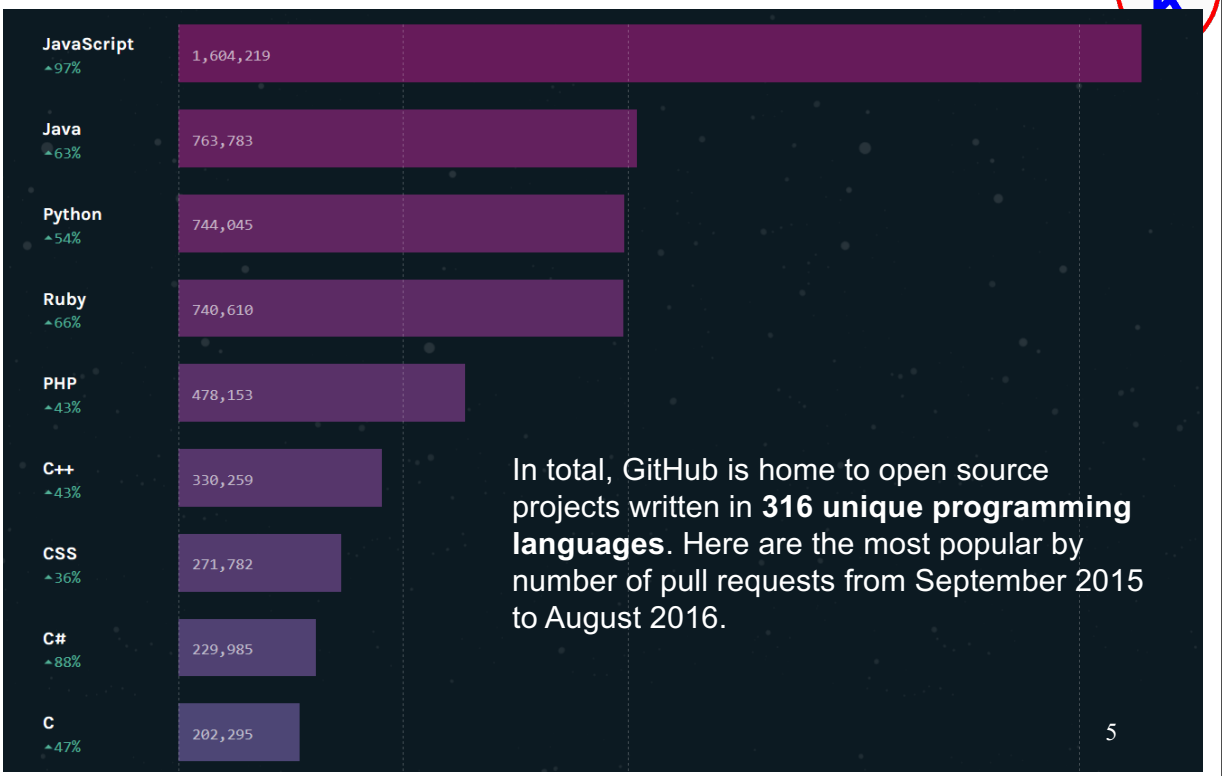
- JavaScript runtime outside of the browser
- Usually used for server-side applications
- Originally only for Linux in 2009
- Now available everywhere
  - (Linux, Windows, Unix, Mac OS X, IBM i, HP NonStop, etc)
- Event loop lets you create efficient code without need to code threads
- Provides access to file systems (i.e. IFS on IBM i)
- Provides basic network capabilities

Want the Latest and Greatest?

Cobol	1959
RPG II	1968
C	1972
RPG III	1978
C++	1983
Python	1991
RPG IV	1994
Java	1995
PHP	1995
Ruby	1995
Node.js	2009

New enough to have learned from previous languages, old enough to have grown very robust

Popularity of JavaScript



In total, GitHub is home to open source projects written in **316 unique programming languages**. Here are the most popular by number of pull requests from September 2015 to August 2016.

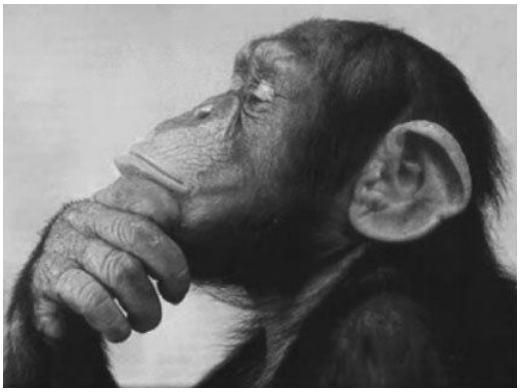
Think About It

In most other languages, web is the main way of making displays…

…modern web displays require JavaScript…

… coding in Java, PHP, Ruby, Python, and even modern RPG will require also coding in JavaScript.

So JavaScript will be the most popular. Why not use it on the back-end, too?

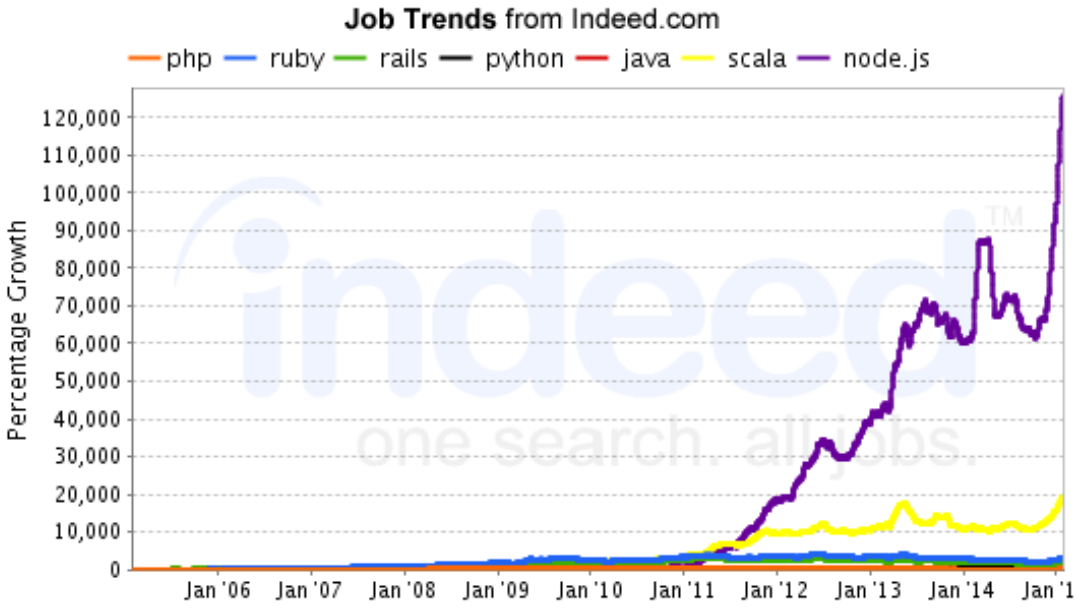


Companies Using Node.js

More Companies…

Big companies have moved from experimenting with Node to deploying it into production. Companies like...

Node Job Explosion



Node.js Philosophy

The philosophy of Node.js is different than other languages.

David's take:

- Languages like RPG or Java try to include everything you'll need
- Node includes very little
- Like Unix philosophy:
  - Write modules that do one thing and do it well
  - Write modules that work together with other modules
  - Write modules that handle streams and events
- What makes Node unique and powerful is the ecosystem!

Support on IBM i

IBM provides support

- via the yum package system
- Runs in PASE
- Db2 access is provided via ODBC driver (or older idb-connector module)
- Source kept in IFS
- Edit with any editor….
  - RDi works fine
  - Notepad++ works fine
  - VS Code is free and is our favorite (so far). Also has integrated debugging!

Demand comes from development community

- No company backing like Zend/Perforce for PHP or PowerRuby for Ruby
- Lots of community support in forums, web sites, etc.

Learning Node / JavaScript

I cannot teach the whole language in this session!

- But maybe you already know JavaScript?
- Or, once you know one language, learning another isn't hard.

Some resources we've found:

- *Sams Teach Yourself Node.js in 24 Hours, by George Ornbo*
  http://a.co/7t52WX3
- *Pro Node.js for Developers by Colin J. Ihrig*
  http://a.co/48uAr1W
- Main website for Node.js, including API docs:
  http://nodejs.org

Also, just search Google for what you're looking for. This can be really helpful!

JavaScript Syntax Basics (1 of 3)

Declaring and Comparing

- declare a variable with var *(alternatives: const, let)*
- type of variable is determine by what is assigned to it – and can change.
- A single = means "assign value"
- Double == means "compare" data types will be converted if necessary
- Triple === means "compare" but result only matches if it's the same data type

```
var myString = "Hello World";
var myNumber = 1;
var myArray = [ "Monday", "Tuesday", "Wednesday", "Thursday", "Friday" ];

if ( myVariable == "something") {
  doSomething();
}
else {
  doSomethingElse();
}

if ( myNumber == "1" ) // works!

if ( myNumber === "1" ) // doesn't work, different types
```


JavaScript Syntax Basics (2 of 3)

```
while ( myNumber > 1) {
  // do something while myNumber > 1
}

do {
  // do while myNumber > 1, test condition at end of loop.
}
while ( myNumber > 1 );

for (var x=1; x<=10; x++) {
  // do something 10 times.
}

var employee_rec = {
    first: "Scott",
    last: "Klement",
    num: 1000
}

for (field in employee_rec) {
  // do something for each field in an "object" (data structure)
  console.log(field + " = " + employee_rec[field]);
}
```

JavaScript Syntax Basics (3 of 3)

```
function printSomething( something ) {
  console.log(something);
}

// prints "Hello World"
printSomething("Hello World");
```

```
const printSomething = (something) => {
  console.log(something);
}

// prints "Hello World"
printSomething("Hello World");
```

```
// functions can be variables – allow for "callbacks"
//   this function automatically calls a routine "num" times.
function repeat( num, callback ) {
  for (var x=1; x<=num; x++) {
    callback(x);
  }
}

// this will print 1-5 on the console display
repeat( 5, printSomething);

// anonymous functions are functions defined on-the-fly just to assign
//  to variables or parameters.  This prints 1-5 with "call number" before it.
repeat( 5, function(n) { printSomething("call number " + n)});
```


Node Modules

Node provides the concept of "modules"

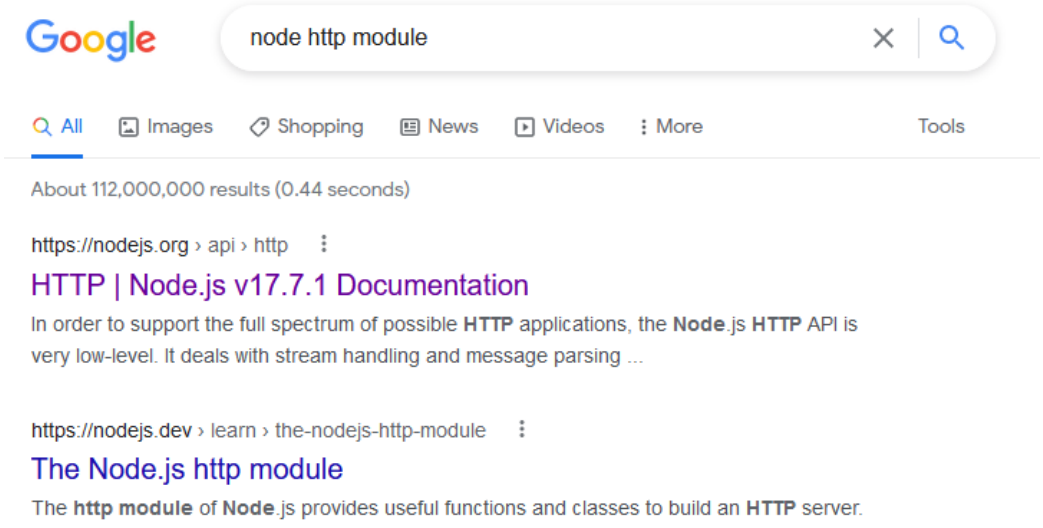
- Libraries (like service programs?) that you can use in your program
- Provided as downloadable packages (lots and lots of them available)
- Or, you can write your own.
- Bring them into your program with the require statement

```
....+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....8

var module = require("module name here");

module.doSomething(); // runs something in the module
```

Easy To Find Docs With Google

Basically, just google "node <thing to find>"

- In this case, the built-in http module documentation…

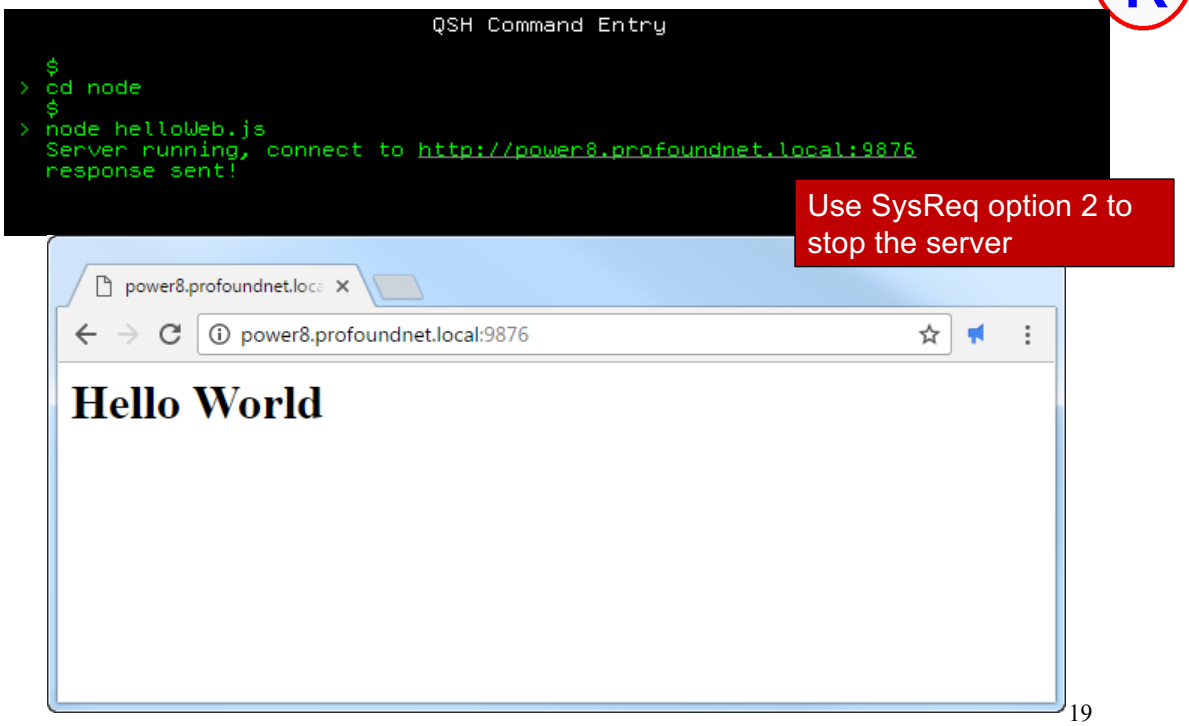


Hello World (1 of 2)

Since the "http" module contains all the code needed to communicate with HTTP, it's very easy to write a simple web server in Node.

```
....+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....8

// Load the http module to create an http server.
var httpServer = require('http');

// Configure our HTTP server to respond with Hello World to all requests.
var server = httpServer.createServer(function (request, response) {
  response.writeHead(200, {"Content-Type": "text/html"});
  response.end("<h1>Hello World</h1>");
  console.log("response sent!");
});

// Listen on port 9876
server.listen(9876);

// Even though this ends the program, it will remain active since
// the node event loop has more to do (due to http server above)
console.log("Server running, connect to http://your-server:9876");
```

Hello World (2 of 2)



The Real Power of Node.js

The real power of Node.js comes from the "ecosystem" of modules that are available to use!

- Most are available with the Node Package Manager (npm)
  - Finds the module and installs it
  - Allows upgrades when needed
  - Installs any dependencies
  - Allows uninstalling when needed
- Sometimes modules are provided other ways
  - commercial software
  - sites like github, etc.
  - examples posted on internet

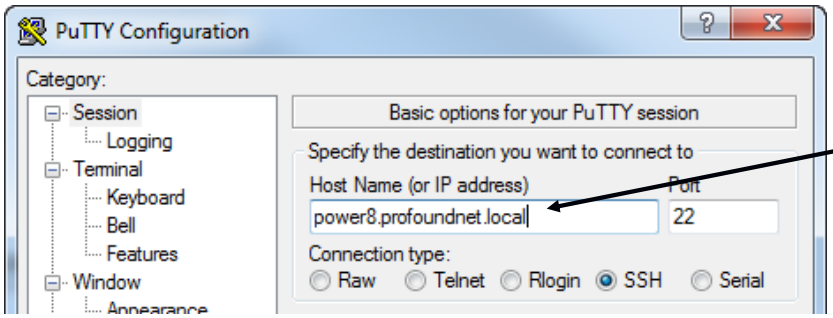
Using a Real Unix Terminal

Node.js on IBM i was written for AIX and runs under PASE. Some tools (npm is one, there are others) try to use Unix terminal features, such a colors, and so assume you are using a Unix terminal emulator.

This is not required for using Node.js, but it does work very nicely, and we prefer it!

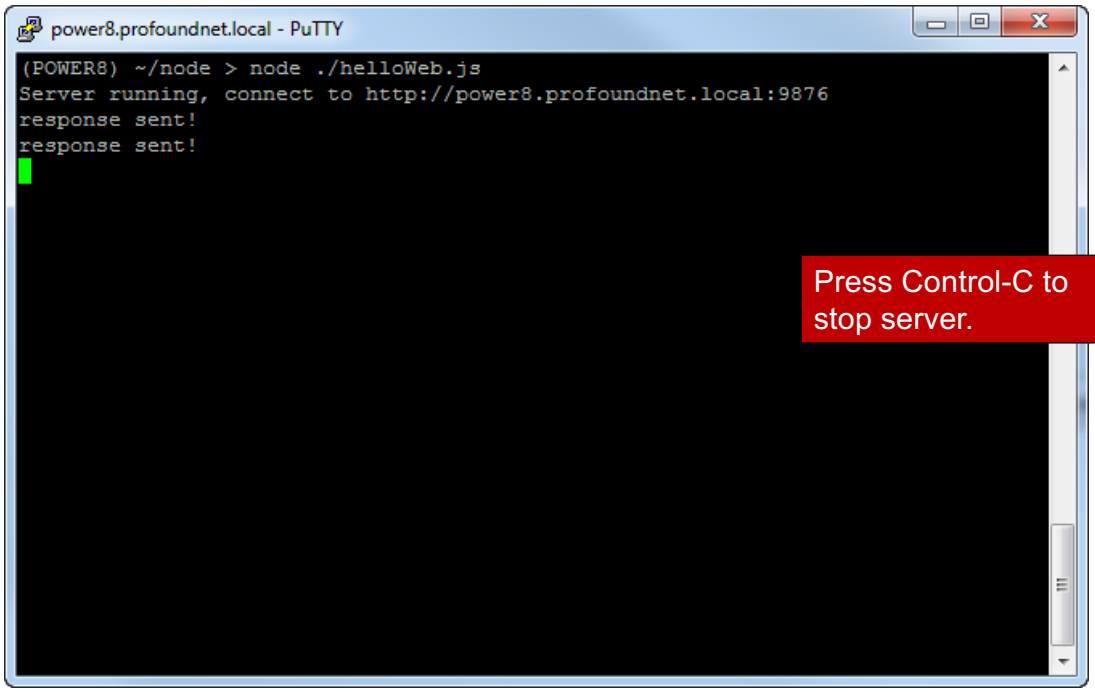
A good way to do that on IBM i is to start the IBM-supplied SSHD and connect with a Unix terminal program such as Putty. http://www.chiark.greenend.org.uk/~sgtatham/putty/

```
STRTCPSVR SERVER(*SSHD)
```



Use the IP address or hostname of your IBM i here

Run Hello World from Putty



Press Control-C to stop server.

Node Package Manager (npm)

NPM is used from the PASE command like (via Putty or 5250)
- `npm list` will list the packages currently installed
- `npm install <package>` will install a package
- `npm update <package>` will update an existing package
- `npm uninstall <package>` will remove an existing package
- `npm search <keyword>` will search for a package

By default packages are listed/installed in the local project. Add `--global` to make it install system-wide. (or `-g` for short!)

By default, it tries to use the most current version of a package available. You can add @VERSION to the package name to install a particular version, such as

```
npm install my-package@1.0.0 --global
```

For example, for a better HTTP server try google: `npm express`

Express-Generator

The basic http module in Node makes it easy to write your own HTTP server, but maybe you want something that does a little more work for you?

Express.js is a very popular web application framework for Node.js.
- makes it easy to build a powerful web site.
- adds routing support
- template engines
- file uploading
- single-page applications
- but still provides support for coding whatever you want in your logic.

Express Generator
- add-on for Express.js that generates applications for you
- installs a command line tool that you run to make things
- build a shell application in seconds!

```
npm install express-generator --global
```

(this will install Express.js as a dependency)

Express-Generator

Once installed, you can generate an application skeleton like this:

```
express yourApp
```

This creates a yourApp directory and generates all of the files and subdirectories to provide a good skeleton of an Express.js application.

```
cd /home/sklement/node
$
express -e demoApp
[messages show generated files]
$
cd demoApp
$
npm install
[messages show building files]
$
npm start
```


Accessing DB2 for i in Node.js

Although IBM provides a node-specific driver called idb-connector, this is deprecated. The current recommendation is to use ODBC support to connect to Db2 for i (even when running on IBM i!)

To install ODBC:

```
cd /path/to/myproject
npm install odbc
```

Like all modules, you require it – then you can use it.

```
const odbc = require("odbc");
const conn = await odbc.connect(`DSN=*LOCAL;NAM=1;CMT=0;DBQ=,*USRLIBL,SKLEMENT`);
```

The connection string sets options used for the connection. Details here:
https://www.ibm.com/docs/en/i/7.4?topic=details-connection-string-keywords

Keyword	Meaning
DSN	Data Source Name (*LOCAL for the local machine)
NAM	Naming 0 = *SQL naming (default), 1 = *SYS naming
CMT	Commitment control. 0=None, 1=*CS, 2=*CHG (default), 3=*ALL, 4=*RR
DBQ	Library List. *USRLIBL can be used as a placeholder for the default user library list. *Note: NAM=1 uses the *LIBL by default only if there is a leading comma.*

Running an SQL Statement

The SQL results are returned asynchronously in a JavaScript array of objects.

```
conn.query("select ORDERREF, ORDERLINE, PRODREF, ORDERQTY, SALETOTAL" +
           "  from SALESDTL", (error, result) => {

  // statement is run in the background
  // this function is called when it is ready

  result.forEach((row) => {

   // this function is repeated for each row available
   // row.ORDERREF, row.ORDERLINE, etc will contain the fields
   // in string format

  });

});
```

NOTICE THIS SYNTAX, ABOVE: `(parm1, parm2) = > { code }`

This is called an "arrow function" and is an alternate way in JavaScript to create a function (which, in turn, is similar to an RPG subprocedure)

Example, ExcelJs

Distributing reports as spreadsheets has been very successful for me, and so I wanted to try it in Node.js.

Google: `nodejs excel spreadsheet`

There are a bunch of them, there are also tools for other spreadsheets (such as Google docs spreadsheets) ExcelJs looked decent, so we installed it.

For the sake of example, this will be installed locally into the project (not system-wide)

```
$
  mkdir spreadsheet
$
  cd spreadsheet
$
  npm install exceljs
```

ExcelJs, Configuring Columns

```
// Create an Excel workbook with one worksheet named "Orders".

var Excel = require("exceljs");
var workbook = new Excel.Workbook();
var worksheet = workbook.addWorksheet("Orders");

// Add column definitions to the worksheet.
// The column keys are named after the DB2 column names.

worksheet.columns = [
    { header: "Order #", key: "ORDERREF", width: 9 },
    { header: "Line #", key: "ORDERLINE", width: 7,
                style:{ numFmt: "0" } },
    { header: "Product #", key: "PRODREF", width: 15 },
    { header: "Ordered Qty", key: "ORDERQTY", width: 12,
                style:{ numFmt: "0" }  },
    { header: "Extended Amount", key: "SALETOTAL", width: 17,
                style:{ numFmt: "$#,##0.00_);[Red]($#,##0.00)" }}
];

worksheet.getRow(1).font = { name: "Calibri", size: 11,
                                    bold: true };
```


ExcelJs, Populating Rows

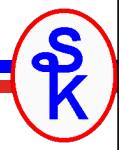
```
// Statement will read from "sales order detail" table.

conn.query("select ORDERREF, ORDERLINE, PRODREF, ORDERQTY, SALETOTAL" +
           "  from SALESDTL", (error, result) => {

  // Loop through the rows returned in the result set

  result.forEach((row) => {
    worksheet.addRow(row);
  });

  // Write the worksheet to the file system, in the current working
  // directory.

  workbook.xlsx.writeFile("orders.xlsx");

});
```

Example, Output

	A	B	C	D	E	F	G
1	**Order #**	**Line #**	**Product #**	**Ordered Qty**	**Extended Amount**		
2	ORD001	1	BAN-001	10	$34.00		
3	ORD001	2	BOX-006	15	$379.50		
4	ORD001	3	PIC-001	10	$39.40		
5	ORD001	4	TRA-001	2	$37.12		
6	ORD002	1	BAN-001	10	$34.00		
7	ORD002	2	BOX-006	10	$177.10		
8	ORD002	3	LAM-001	4	($45.96)		
9	ORD002	4	MAT-001	1	$15.36		
10	ORD002	5	POW-002	12	$4,920.00		
11	ORD003	1	BOX-001	5	$32.00		
12	ORD003	2	BOX-002	5	$64.30		
13	ORD004	1	MAT-002	13	$54.86		
14	ORD004	2	POW-002	1	$410.00		
15	ORD004	3	SOF-001	25	$250.00		
16	ORD005	1	BOX-001	2050	$13,120.00		
17	ORD005	2	BOX-002	1300	$16,718.00		
18	ORD005	3	BOX-003	450	$1,686.30		

Orders

Example, Node Mailer



It would be convenient to be able to e-mail the spreadsheets we created. For example, a nightly batch job might create reports, and need to send them to the appropriate people.

Google: `nodejs send email`

We picked nodemailer, looked like an easy to use tool for e-mailing.

```
$
  mkdir email
$
  cd email
$
  npm install nodemailer
```

Nodemailer, configuring SMTP

To send e-mail using the IBM i SMTP server, just create a transport using SMTP to the local system.

```
var nodemailer = require("nodemailer");

var transporter = nodemailer.createTransport(
      "smtp://localhost");
```

Or, perhaps you'd rather use a separate e-mail server? For example, an Exchange server?

```
var transporter = nodemailer.createTransport(
      "smtp://smtp.example.com");
```

Perhaps the server requires a userid/password?

```
var transporter = nodemailer.createTransport(
      "smtp://myUserId:myPassword@smtp.office365.com");
```


Nodemailer, Building a Message

A JavaScript object (like an RPG data structure) contains fields for the various things needed in an e-mail message

- from = sender's e-mail address
- to = recipient's e-mail address
- subject = message subject
- html = body of e-mail in HTML format (can be as long as needed)
- attachments = JavaScript array of IFS files to include as attachments

```
var message = {
    from: "Node.js Email Example <example@company.com>",
    to: "Scott Klement <sklement@example.com>",
    subject: "Node.js Email Example",
    html: "<b>Sent from Node.js on IBM i</b>",
    attachments: [{
      path: "orders.xlsx"
    }]
};
```

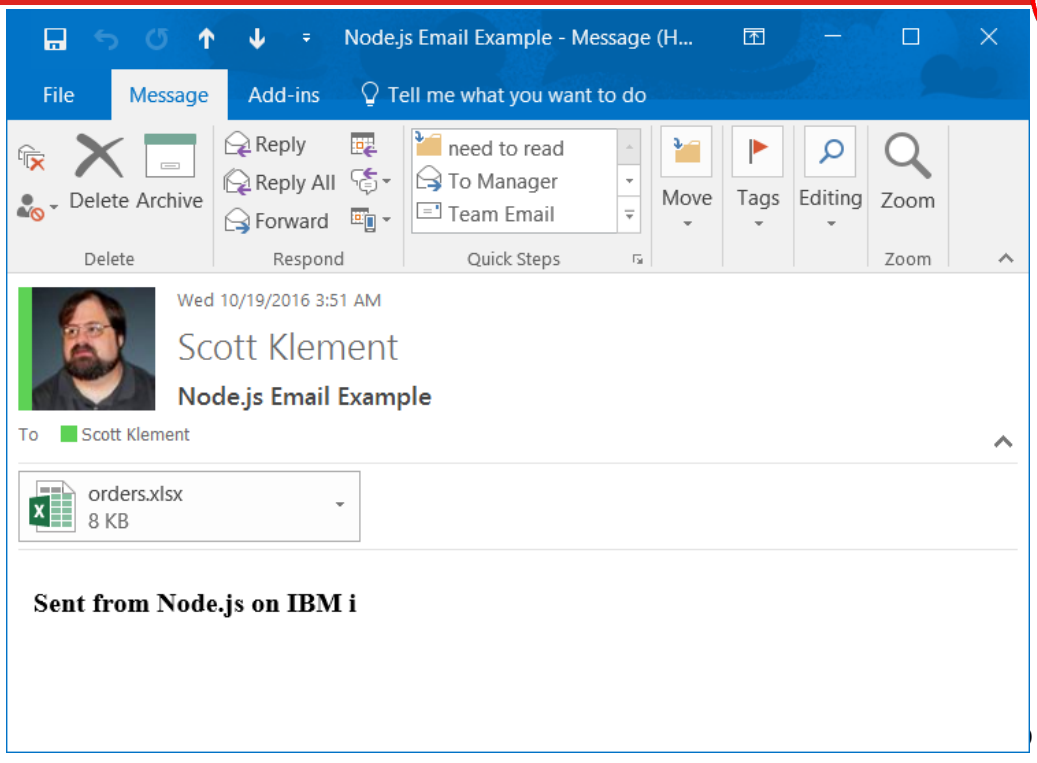
Nodemailer, Sending a Message

The transporter we created earlier can send the message.

- message = pass the message object (see last slide) as first parameter
- callback function = second parameter is a function that is called when the message has been sent. (message is sent asynchronously)

```
transporter.sendMail(message, function(error, info) {
  if (error) {
    console.log(error);
  }
});
```


Nodemailer, Output (in Outlook)



Final Thoughts

- JavaScript is a powerful, robust, popular language
- Now you can run server-side JavaScript on IBM i with Node.js
- The real power of Node.js comes from the ecosystem
- Small tools that are well-written and powerful
- Designed to fit together with other tools so you can build whatever you need

- We have demonstrated only a small number of tools
- But enough that you can see how powerful this is?

This Presentation

You can download a PDF copy of this presentation and the sample code that we used from

http://www.scottklement.com/presentations/

Thank you!