D3 in practice

Ali Almossawi
SFHTML5, August 2015
Mozilla

A team of statisticians

Engineering

MetricsGraphics.js

Design

webwewant.mozilla.org

Research

How do we measure code quality?
Vissarion Belinsky
Manages Mikhail Bakunin
Team size 1

Staff in each timezone
1 (median), 1 (mean)

Potential lost hours*
0 hours (between staff)
0 hours (between manager and staff)

Maximum time difference
0 hours (between staff)
0 hours (between manager and staff)

Largest group in the same timezone
1 staff, 100% of team are in UTC+6

* The difference between the timezone with the largest group of staff (mode) and the farthest timezone from the mode.
Design Structure Matrix (DSM)

Also known as an adjacency matrix or a dependency matrix
\[ \begin{array}{ccccccc}
A & B & C & D & E & F \\
\hline
A & 0 & 1 & 1 & 0 & 0 & 0 \\
B & 0 & 0 & 0 & 1 & 0 & 0 \\
C & 0 & 0 & 0 & 0 & 1 & 0 \\
D & 0 & 0 & 0 & 0 & 0 & 0 \\
E & 0 & 0 & 0 & 0 & 0 & 1 \\
F & 0 & 0 & 0 & 0 & 0 & 0 \\
\end{array} \]

\[ M^0 \]

\( \alpha \rightarrow \beta \quad \text{\(\alpha\) depends on \(\beta\)} \)
\( \alpha \) depends on \( \beta \)

\[
\begin{array}{ccccccc}
\text{A} & & & & & & \\
\text{B} & & & & & & \\
\text{C} & & & & & & \\
\text{D} & & & & & & \\
\text{E} & & & & & & \\
\text{F} & & & & & & \\
\end{array}
\]

\[
M = \begin{bmatrix}
0 & 1 & 1 & 0 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 \\
\end{bmatrix}
\]
\[ \alpha \rightarrow \beta \quad \alpha \text{ depends on } \beta \]
$\alpha \rightarrow \beta \quad \alpha$ depends on $\beta$
\[ \begin{array}{ccccccc}
A & B & C & D & E & F \\
\hline
A & 0 & 0 & 0 & 0 & 0 & 1 \\
B & 0 & 0 & 0 & 0 & 0 & 0 \\
C & 0 & 0 & 0 & 0 & 0 & 0 \\
D & 0 & 0 & 0 & 0 & 0 & 0 \\
E & 0 & 0 & 0 & 0 & 0 & 0 \\
F & 0 & 0 & 0 & 0 & 0 & 0 \\
\end{array} \]

\[ M^3 \]

\[ \alpha \rightarrow \beta \quad \alpha \text{ depends on } \beta \]
\[ \alpha \rightarrow \beta \quad \alpha \text{ depends on } \beta \]

\[
\begin{array}{ccccccc}
A & B & C & D & E & F \\
\hline
A & 0 & 0 & 0 & 0 & 0 & 0 \\
B & 0 & 0 & 0 & 0 & 0 & 0 \\
C & 0 & 0 & 0 & 0 & 0 & 0 \\
D & 0 & 0 & 0 & 0 & 0 & 0 \\
E & 0 & 0 & 0 & 0 & 0 & 0 \\
F & 0 & 0 & 0 & 0 & 0 & 0 \\
\end{array}
\]

\[M^4\]
The variable $\alpha$ depends on $\beta$.

The transition matrix $\mathbf{M}$ is given by:

$$
\begin{bmatrix}
A & B & C & D & E & F \\
A & 0 & 1 & 1 & 1 & 1 & 1 \\
B & 0 & 0 & 0 & 1 & 0 & 0 \\
C & 0 & 0 & 0 & 0 & 1 & 1 \\
D & 0 & 0 & 0 & 0 & 0 & 0 \\
E & 0 & 0 & 0 & 0 & 0 & 1 \\
F & 0 & 0 & 0 & 0 & 0 & 0 \\
\end{bmatrix}
$$

The formula for the limit state is:

$$
\mathbf{R} = \sum \mathbf{M}^n
$$
The gfx module in Firefox 20, direct dependencies (left), direct+indirect dependencies (right)
You can sort a DSM based on what’s important to you
The gfx module in Firefox 20, direct dependencies (left), direct+indirect dependencies (right)
Say we want to see team distributions in an organization

Sort on timezone then office then manager
INITECH Staff, direct reports (left), direct+indirect reports (right)
Ito Jinsai
Manages Samuel Bold
Team size 42

Staff in each timezone
4 (median), 4 (mean)

Potential lost hours*
20 hours (between staff)
0 hours (between manager and staff)

Maximum time difference
20 hours (between staff)
20 hours (between manager and staff)

Largest group in the same timezone
13 staff, 31% of team are in UTC-8

* The difference between the timezone with the largest group of staff (mode) and the farthest timezone from the mode.
Augustus De Morgan
Manages William Hazlitt
Team size 5

Staff in each timezone
5 (median), 5 (mean)

Potential lost hours*
0 hours (between staff)
10 hours (between manager and staff)

Maximum time difference
0 hours (between staff)
10 hours (between manager and staff)

Largest group in the same timezone
5 staff, 100% of team are in UTC+0

* The difference between the timezone with the largest group of staff (mode) and the farthest timezone from the mode.
Friedrich Schelling
Manages Thomas Arnold
Team size 7

Staff in each timezone
4 (median), 4 (mean)

Potential lost hours*
18 hours (between staff)
10 hours (between manager and staff)

Maximum time difference
18 hours (between staff)
10 hours (between manager and staff)

Largest group in the same timezone
5 staff, 71% of team are in UTC+12

* The difference between the timezone with the largest group of staff (mode) and the farthest timezone from the mode.
Archibald Alison
Manages Peter Browne
Team size 17

Staff in each timezone
9 (median), 9 (mean)

Potential lost hours*
17 hours (between staff)
2 hours (between manager and staff)

Maximum time difference
17 hours (between staff)
15 hours (between manager and staff)

Largest group in the same timezone
16 staff, 94% of team are in UTC-8

* The difference between the timezone with the largest group of staff (mode) and the farthest timezone from the mode.
Ronnie Corbett
Manages Lord Kames
Team size 299

Staff in each timezone
17 (median), 25 (mean)

Potential lost hours*
20 hours (between staff)
0 hours (between manager and staff)

Maximum time difference
20 hours (between staff)
20 hours (between manager and staff)

Largest group in the same timezone
85 staff, 28% of team are in UTC-8

* The difference between the timezone with the largest group of staff (mode) and the farthest timezone from the mode.
Code and demo

github.com/almossawi/d3-matrix
1. Data
2. Scales
3. Data-join
4. Ticks
5. Voronoï
6. Events
7. Transitions
8. Stats and charts
1. Data
2. Scales
3. Data-join
4. Ticks
5. Voronoi
6. Events
7. Transitions
8. Stats and charts
<table>
<thead>
<tr>
<th></th>
<th>Name</th>
<th>Manager's Name</th>
<th>Location</th>
<th>Region</th>
<th>Timezone</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Peter Browne</td>
<td>Archibald Alison</td>
<td>Portland</td>
<td>USA</td>
<td>-8</td>
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<tr>
<td>2</td>
<td>Thomas Browne</td>
<td>Archibald Alison</td>
<td>Portland</td>
<td>USA</td>
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<tr>
<td>3</td>
<td>Claude Buffler</td>
<td>Archibald Alison</td>
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<td>Richard Burton</td>
<td>Archibald Alison</td>
<td>Portland</td>
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<td>Portland</td>
<td>USA</td>
<td>-8</td>
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<td>Portland</td>
<td>USA</td>
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<td>John Toland</td>
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<td>USA</td>
<td>-8</td>
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<td>George Turnbull</td>
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<td>32</td>
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<td>Portland</td>
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<td>Portland</td>
<td>USA</td>
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<td>USA</td>
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<td>USA</td>
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<tr>
<td>50</td>
<td>Kumazawa Banzai</td>
<td>Ito Jinsai</td>
<td>Portland</td>
<td>USA</td>
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<tr>
<td>51</td>
<td>Louis de La Forge</td>
<td>Portland</td>
<td>USA</td>
<td>-8</td>
<td></td>
</tr>
</tbody>
</table>
Employees (csv) → Process data → Names and geo (txt) → Dependencies (csv) → Process matrix → Dependencies (csv)

- Peter Browne, USA, -8
- Thomas Browne, USA, -8
- Claude Buffier, USA, -8

Dependencies:
- from_employee, to_employee
  - 1,2
  - 2,3

Process data:
- α processes β, outputs γ

β processes α, outputs γ
employees-dependencies.csv

<table>
<thead>
<tr>
<th>from_employee</th>
<th>to_employee</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

employees.txt

- Peter Browne, USA, -8
- Thomas Browne, USA, -8
- Claude Buffier, USA, -8

```javascript
// d3.js code

const data = d3.csv('data/employees-dependencies.csv', function(data) {
  return data;
});

const textData = d3.text('data/employees.txt', function(text) {
  return text;
});

// do stuff

// End of d3.js code
```
var args = {
    padding: 52,
    matrix_height: 800,
    employee_data: {}
};

1  d3.csv.parseRows(text).forEach(function(row, i) {
2    args.employee_data[++i] = {
3        name: row[0],
4        region: row[1],
5        timezone: row[2]
6    };
7  });

Peter Browne,USA,-8  --->  ["Peter Browne", "USA", "-8"]
Thomas Browne,USA,-8  --->  ["Thomas Browne", "USA", "-8"]
```javascript
var nested = d3.nest()
  .key(function(d) {
    return d.name;
  })
  .entries(data);
```
```json
[
{
  "name": "jill",
  "date": "2015-01-01"
},
{
  "name": "jill",
  "date": "2015-01-02"
},
{
  "name": "jack",
  "date": "2015-01-01"
},
{
  "name": "jack",
  "date": "2015-01-02"
}
]
```
Object

- dependencies: Array[863]
  - employee_count: 299
- employee_data: Object
  - in_manager_view: false
- managers: Array[57]
- managers_team: Object
  - matrix_height: 800
  - padding: 52
- voronoi: function t(n)
- x: function i(n)
- y: function i(n)
- __proto__: Object
var svg = d3.select('.dsm').append('svg').attr('width', args.matrix_height).attr('height', args.matrix_height);

svg.append("rect")
  .attr("width", args.matrix_height - (args.padding * 2))
  .attr("height", args.matrix_height - (args.padding * 2))
  .attr('x', args.padding)
  .attr('y', args.padding);
```javascript
var svg = d3.select('.dsm')
    .append('svg')
    .attr('width', args.matrix_height)
    .attr('height', args.matrix_height);

svg.append("rect")
    .attr("width", args.matrix_height - (args.padding * 2))
    .attr("height", args.matrix_height - (args.padding * 2))
    .attr('x', args.padding)
    .attr('y', args.padding);
```
1. Data
2. Scales
3. Data-join
4. Ticks
5. Voronoi
6. Events
7. Transitions
8. Stats and charts
domain

range

0 299

opx 800px
args.x = args.y = d3.scale.linear()
  .domain([1, 299])
  .range([0, 800]);

args.x(1); // 0
args.x(299); // 800
args.x(150); // 400
var dots = svg.append('g')
    .attr('class', 'dot');
1. Data
2. Scales
3. Data-join
4. Ticks
5. Voronoi
6. Events
7. Transitions
8. Stats and charts
```javascript
args.dependencies = [
    {from_employee: 1, to_employee: 2},
    {from_employee: 3, to_employee: 2}
]

dots.selectAll('rect')
  .data(args.dependencies)
  .enter().append('rect')
  .attr('class', function(d) {
    return 'm' + d.to_employee + ' e' + d.from_employee;
  })
  .attr('width', 1)
  .attr('height', 1)
  .attr('transform', function(d) {
    return "translate(" + args.x(d.to_employee).toFixed(2) + "," + args.y(d.from_employee).toFixed(2) + ")";
  }); // toFixed is to avoid DOM diarrhea (TypeID)
args.dependencies = [
    {from_employee: 1, to_employee: 2},
    {from_employee: 3, to_employee: 2}
]

dots.selectAll('rect')
  .data(args.dependencies)
  .enter().append('rect')
  .attr('class', function(d) {
    return 'm' + d.to_employee + ' e' + d.from_employee;
  })
  .attr('width', 1)
  .attr('height', 1)
  .attr('transform', function(d) {
    return "translate(" + args.x(d.to_employee).toFixed(2)
    + "," + args.y(d.from_employee).toFixed(2) + ")";
  }); // toFixed is to avoid DOM diarrhea (新浪财经)
args.dependencies = [
    {from_employee: 1, to_employee: 2},
    {from_employee: 3, to_employee: 2}
]

dots.selectAll('rect')
  .data(args.dependencies)
  .enter().append('rect')
  .attr('class', function(d) {
    return 'm' + d.to_employee + ' e' + d.from_employee;
  })
  .attr('width', 1)
  .attr('height', 1)
  .attr('transform', function(d) {
    return "translate(" + args.x(d.to_employee).toFixed(2)
    + "," + args.y(d.from_employee).toFixed(2) + ")";
  }); // toFixed is to avoid DOM diarrhea (♂_♂)
args.dependencies = [
    {from_employee: 1, to_employee: 2},
    {from_employee: 3, to_employee: 2}
]

dots.selectAll('rect')
    .data(args.dependencies)
    .enter().append('rect')
    .attr('class', function(d) {
        return 'm' + d.to_employee + ' e' + d.from_employee;
    })
    .attr('width', 1)
    .attr('height', 1)
    .attr('transform', function(d) {
        return "translate(" + args.x(d.to_employee).toFixed(2)
            + "," + args.y(d.from_employee).toFixed(2) + ")";
    }); // toFixed is to avoid DOM diarrhea (ಥ﹏ಥ)
args.dependencies = [
    {from_employee: 1, to_employee: 2},
    {from_employee: 3, to_employee: 2}
]

dots.selectAll('rect')
data(args.dependencies)
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.attr('class', function(d) {
    return 'm' + d.to_employee + ' e' + d.from_employee;
})
.attr('width', 1)
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.attr('transform', function(d) {
    return "translate(" + args.x(d.to_employee).toFixed(2)
    + "," + args.y(d.from_employee).toFixed(2) + ")";
}); //toFixed is to avoid DOM diarrhea (ಥ﹏ಥ)
args.dependencies = [
    {from_employee: 1, to_employee: 2},
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dots.selectAll('rect')
  .data(args.dependencies)
  .enter().append('rect')
  .attr('class', function(d) {
    return 'm' + d.to_employee + ' e' + d.from_employee;
  })
  .attr('width', 1)
  .attr('height', 1)
  .attr('transform', function(d) {
    return "translate(" + args.x(d.to_employee).toFixed(2) + "," + args.y(d.from_employee).toFixed(2) + ")";
  }); // toFixed is to avoid DOM diarrhea (ಥ﹏ಥ)
.dot rect {
    fill: #d2e4ed;
    opacity: 0.9;
}

1. Data
2. Scales
3. Data-join
4. Ticks
5. Voronoi
6. Events
7. Transitions
8. Stats and charts
.EMEA {
    color: #71a6ea;
    fill: #71a6ea;
}

.USA {
    color: #05b378;
    fill: #05b378;
}

.CASCADE {
    color: #db4437;
    fill: #db4437;
}
var timezone_x = svg.append('g')
  .attr('class', 'timezone-x');

timezone_x.selectAll("rect")
  .data(dedup(args.dependencies, 'to_employee'))
  .enter().append("rect")
  .attr('class', function(d) {
    return args.employee_data[d.to_employee].region
    + ' m' + d.to_employee;
  })
  .attr('width', 2)
  .attr('height', 6)
  .attr("transform", function(d) {
    return "translate(" + args.x(d.to_employee).toFixed(2)
    + "," + (args.padding - 6).toFixed(2) + ");";
  });
1. Data
2. Scales
3. Data-join
4. Ticks
5. Voronoi
6. Events
7. Transitions
8. Stats and charts
Percy Williams Bridgman
Manages Mary Wollstonecraft
Team size 24

Staff in each timezone
4 (median), 4 (mean)

Potential lost hours*
15 hours (between staff)
4 hours (between manager and staff)

Maximum time difference
15 hours (between staff)
11 hours (between manager and staff)

Largest group in the same time zone
7 staff, 25% of team are in UTC+12

* The difference between the timezone with the largest group of staff (mode) and the farthest timezone from the mode.
var dots_rollover = svg.append('g')
  .attr('class', 'dot-rollover');

args.voronoi = d3.geom.voronoi()
  .x(function(d) {
    return args.x(d.to_employee);
  })
  .y(function(d) {
    return args.y(d.from_employee);
  })
  .clipExtent([[0, 0],
               [args.matrix_height - args.padding,
                args.matrix_height - args.padding]]);
var dots_rollover = svg.append('g')
  .attr('class', 'dot-rollover');

args.voronoi = d3.geom.voronoi()
  .x(function(d) {
    return args.x(d.to_employee);
  })
  .y(function(d) {
    return args.y(d.from_employee);
  })
  .clipExtent([[0, 0], [args.matrix_height - args.padding, args.matrix_height - args.padding]]);
dots_rollover.selectAll("path")
  .data(args.voronoi(args.dependencies))
  .enter().append('path')
  .attr("d", function(d) {
    return "M" + d.join("L") + "Z";
  })
  .attr("class", function(d) {
    return "m" + d.point.to_employee + " e" + d.point.from_employee;
  })
  .on('mouseover', dotMouseOver(args))
  .on('click', dotClick(args));
dots_rollover.selectAll("path")
  .data(args.voronoi(args.dependencies))
  .enter().append('path')
  .attr("d", function(d) {
    return "M" + d.join("L") + "Z";
  })
  .attr("class", function(d) {
    return "m" + d.point.to_employee
    + " e" + d.point.from_employee;
  })
  .on('mouseover', dotMouseOver(args))
  .on('click', dotClick(args));
dots_rollover.selectAll("path")
  .data(args.voronoi(args.dependencies))
  .enter().append('path')
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    return "M" + d.join("L") + "Z";
  })
  .attr("class", function(d) {
    return "m" + d.point.to_employee + " e" + d.point.from_employee;
  })
  .on('mouseover', dotMouseOver(args))
  .on('click', dotClick(args));
dots_rollover.selectAll("path")
  .data(args.voronoi(args.dependencies))
  .enter().append('path')
  .attr("d", function(d) {
    return "M" + d.join("L") + "Z";
  })
  .attr("class", function(d) {
    return "m" + d.point.to_employee + " e" + d.point.from_employee;
  })
  .on('mouseover', dotMouseOver(args))
  .on('click', dotClick(args));
Array[4]
 ▼ 0: Array[2]
    ▼ 0: 389.82358530029154
    ▼ 1: 742.161074
    length: 2
    ▼ __proto__: Array[0]
 ▼ 1: Array[2]
    ▼ 0: 478.9422818
    ▼ 1: 742.161074
    length: 2
    ▼ __proto__: Array[0]
 ▼ 2: Array[2]
    ▼ 0: 478.0080536
    ▼ 1: 739.8255035
    length: 2
    ▼ __proto__: Array[0]
 ▼ 3: Array[2]
    ▼ 0: 390.4432264716785
    ▼ 1: 739.8255035
    length: 2
    ▼ __proto__: Array[0]
    ▼ length: 4
 ▼ point: Object
    from_employee: "296"
    to_employee: "172"
    ▼ __proto__: Object

> $('path.e296.m172')

[ <path d="M389.82358530029154,742.161074L478.9422818,742.161074L478.0080536,739.8255035L390.4432264716785,739.8255035Z" class="m172 e296"></path> ]
// manager comes from the dropdown or from the clicked voronoi cell
var team = args.dependencies.filter(function(employee, i) {
    return employee.to_employee === manager;
});
regenerateVoronoi(team);
function dotMouseOver(args) {
    return function(d) {
        d = d.point;
        ...
    }
}
function dotMouseOver(args) {
  ...
  d3.select('.to-employee')
    .attr('x', args.x(d.to_employee))
    .attr('y', 10)
    .text(args.employee_data[d.to_employee].name)
    .attr('text-anchor', function() {
      if (d.to_employee < 20) {
        return 'start';
      } else if (d.to_employee > args.employee_count - 20) {
        return 'end';
      } else {
        return 'middle';
      }
    });
  ...
}
function dotMouseOver(args) {
    return function(d) {
        console.log(d3.select(this));
        d = d.point;
        ...
    }
}
[Array[1]]

0: Array[1]

0: path

__data__: Array[5]

0: Array[2]

1: Array[2]

2: Array[2]

3: Array[2]

4: Array[2]

length: 5

point: Object

  from_employee: "228"
  to_employee: "21"

__proto__: Object

__proto__: Array[0]

__onclick: function (e)

__onmouseover: function (e)
1. Data
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8. Stats and charts
```javascript
dots.attr('width', 0)
  .attr('height', 0)
  .transition()
    .delay(1000)
    .duration(function(d, i) {
      return i * Math.random() % 2000;
    })
  .attr('width', 1)
  .attr('height', 1);
```
```javascript
MG.data_graphic({
  title: "UFO Sightings",
  description: "Yearly UFO sightings from 1945 to 2010.",
  data: JSON.parse($('textarea').val()),
  markers: [{"year": 1964, 'label': "The Creeping Terror"},
            {"year": 1975, 'label': "..."},
            {"year": 1976, 'label': "..."},
            {"year": 1977, 'label': "..."},
            {"year": 1978, 'label': "..."},
            {"year": 1979, 'label': "..."},
            {"year": 1980, 'label': "..."}],
  width: 400,
  height: 250,
  target: ".result",
  x_accessor: "year",
  y_accessor: "sightings",
  interpolate: "monotone"
});
```
var line = d3.svg.line()
  .x(args.scalefns.xf)
  .y(args.scalefns.yf)
  .interpolate(args.interpolate)
  .tension(args.interpolate_tension);

1 existing_line
2   .transition()
3   .duration(args.transition_duration)
4   .attr('d', line(args.data));
1. Data
2. Scales
3. Data-join
4. Ticks
5. Voronoi
6. Events
7. Transitions
8. Stats and charts
Ronnie Corbett
Manages Lord Kames
Team size 299

Staff in each timezone
17 (median), 25 (mean)

Potential lost hours*
20 hours (between staff)
0 hours (between manager and staff)

Maximum time difference
20 hours (between staff)
20 hours (between manager and staff)

Largest group in the same timezone
85 staff, 28% of team are in UTC-8

* The difference between the timezone with the largest group of staff (mode) and the farthest timezone from the mode.
Ronnie Corbett
Manages Lord Kames
Team size 299

Staff in each timezone
17 (median), 25 (mean)

Potential lost hours*
20 hours (between staff)
0 hours (between manager and staff)

Maximum time difference
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Potential lost hours*
20 hours (between staff)
0 hours (between manager and staff)

Maximum time difference
20 hours (between staff)
20 hours (between manager and staff)

Largest group in the same timezone
85 staff, 28% of team are in UTC-8

* The difference between the timezone with the largest group of staff (mode) and the farthest timezone from the mode.
d3.min

d3.max

d3.mean

d3.median

d3.quantile
Arthur Collier
Manages Friedrich Engels
Team size 18

Staff in each timezone
2 (median), 3 (mean)

Potential lost hours*
14 hours (between staff)
14 hours (between manager and staff)

Maximum time difference
20 hours (between staff)
20 hours (between manager and staff)

Largest group in the same time zone
6 staff, 33% of team are in UTC+6

* The difference between the timezone with the largest group of staff (mode) and the farthest timezone from the mode.
// show team members across timezones for this manager
MG.data_graphic({
data: args.managers_team[d.to_employee].timezones,
target: '.managers-team-across-timezones',
x_accessor: 'value',
y_accessor: 'key',
chart_type: 'bar',
max_x: 85
});
This is an interactive Design Structure Matrix (DSM) where a dot indicates that the employee along the left side reports to the employee along the top. The DSM is a visibility matrix, which means that in addition to showing direct reports, we also show indirect reports. Hence, an employee is shown as reporting to his or her direct manager, as well as to his or her manager’s manager and so on. We achieve this through matrix multiplication.

The term for the number of managers that an employee reports to, directly or indirectly, is fan-out and the term for the number of staff that report to a particular manager is fan-in. The manager with the largest team is hence the manager with the largest fan-in, and taking an average of the fan-out for all staff gives us a sense of the average distance to the CEO.

Depending on how the matrix is sorted, different clusters of dots indicate different things. When we sort the matrix by timezone, then location then manager—the current case—vertical lines show staff who are either physically close to each other or in the same timezone. The more spread out a vertical line is, the more spread out a manager’s team members are.

You can mouse-over the matrix to reveal details about its various parts or view details about a particular manager’s team by clicking anywhere on the matrix or by choosing a manager from the dropdown.

How spread out are teams?

Of the 57 teams at INTECH, 23 teams are entirely in the same timezone or within two hours of the same timezone; 12 teams have a maximum time difference of 18 to 20 hours.
Code and demo

github.com/almossawi/d3-matrix
D3 is a useful low-level toolkit
Portable

*SVG deployed to the Web*

Interactive

*You can show your data in layers*

Free

*No licenses*

Extensible

*HTML, JavaScript, SVG, CSS*
What do we want to visualize?

How do we intend to visualize it?
What do we want to visualize?

How do we intend to visualize it?
How might we think about organizational structure?

Our broad question
How might we think about organizational structure?

1. How are employees distributed throughout the organization?
2. How flat is the organization?
3. Which teams are the most spread-out?
4. How big are teams?
5. To what extent are offices used?
“We found that one-third of people, regardless of profession, do their job because they see a meaning in it.”

Have you heard about the janitors at that coma ward who change the wall art in patients’ rooms?

By way of Laszlo Bock, Talk at the Bay Area Book Festival
“[Top teams] achieve superior levels of participation, cooperation, and collaboration because their members trust one another... and have confidence in their effectiveness as a team.”

“[That’s] the biggest predictor of team success.”

Druskat and Wolff via Ross, Make Your Good Team Great, Harvard Business Review
“We identified three aspects of communication that affect team performance.”

“The most valuable form of communication is **face-to-face**. The next most valuable is by phone or videoconference, but with a caveat...”
“Products tend to mirror the architectures of the organizations in which they are developed.”

MacCormack, Exploring the Duality between Product and Organizational Architectures: A Test of the “Mirroring” Hypothesis
What do we want to visualize?

How do we intend to visualize it?
Odd one out
Maternal-mortality rate, per 100,000 live births

Source: Kassebaum et al, Lancet
A graphic is often meant to maximize **understandability**

Ideally, we want the reader to grasp our work with minimal investment.

Any extra acts of cognition that users are made to perform incur a **debt** that we must then relieve in the form of increased **value**

*More sophisticated insights or the affordance of particular qualities*
The path from the familiar to the novel ought to be fraught with caution and reflection
It looks nice
It fits with our mental model of hierarchy
At a glance, it gives us a sense of how big and how deep the organization is

It’s not compact
It’s difficult to compare multiple charts
It doesn’t really help us answer our questions
Alexander Simoes
<table>
<thead>
<tr>
<th>Question</th>
<th>Tree</th>
<th>Sunburst</th>
<th>Treemap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answers our questions?</td>
<td>3 out of 5</td>
<td>2 out of 5</td>
<td>2 out of 5</td>
</tr>
<tr>
<td>Compact?</td>
<td>Not really</td>
<td>Kind of</td>
<td>Yes</td>
</tr>
<tr>
<td>Comparability?</td>
<td>Not really</td>
<td>Kind of</td>
<td>Kind of</td>
</tr>
</tbody>
</table>

1. How are employees distributed throughout the organization?
2. How flat is the organization?
3. Which teams are the most spread-out?
4. How big are teams?
5. To what extent are offices used?
An organization is a system

*Albeit, its fundamental unit is a person rather than a component*
Complexity

Internal dynamics

External Influences

Potential to degrade with time
<table>
<thead>
<tr>
<th></th>
<th>Tree</th>
<th>Sunburst</th>
<th>Treemap</th>
<th>DSM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answers our questions?</td>
<td>3 out of 5</td>
<td>2 out of 5</td>
<td>2 out of 5</td>
<td>4 out of 5</td>
</tr>
<tr>
<td>Compact?</td>
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<td>Kind of</td>
<td>Yes</td>
<td>Yes</td>
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</table>

1. How are employees distributed throughout the organization?
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4. How big are teams?
5. To what extent are offices used?
How are employees distributed throughout the organization?

*sort order*

How flat is the organization?

*average horizontal cardinality (fan-out)*

Which teams are the most spread-out?

*vertical spread*

How big are teams?

*vertical cardinality (fan-in)*

To what extent are offices used?
Final thought
“The #1 neglected topic in statistics is measurement...
the connection between the data you gather and the
underlying object of your study”

Andrew Gelman, What’s the most important thing in statistics that’s not in the textbooks?
Measuring $\in$ Thinking

It turns out that thinking is quite important :)
Encodings

*Position, area, color, chart types*
Maybe I shouldn’t show everything at once

Maybe I shouldn’t show everything

Who is this for?
♫ How could this happen to me?
♫ I’ve made my mistakes...