

Research Methods

CSCI 8901:
Visualizing Your Research

Prof. Tim Wood
GWU

Research Pitch

Next class is our last class!

5 minute research presentation

- Extended elevator pitch

Get us excited about your research area!

Visuals Matter

Slides

Posters

Papers

- Diagrams
- Graphs
- Even fonts and formatting!

You want your work to look:

- Professional
- Attractive
- Memorable
- Informative

Let's go back in time...

Tim Wood's Thesis Defense

Sometime in April, 2011
Somewhere in farm country, Massachusetts

Data Centers

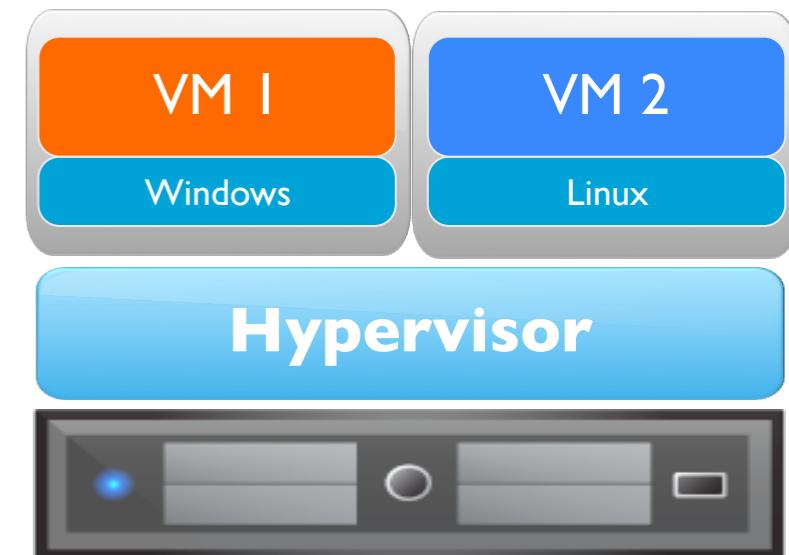
- **Infrastructure as a Service** clouds rent server and storage resources on demand
- Data Centers are BIG server farms
 - Clusters of 10,000s of servers
 - Growing to 100s of thousands
- Host many application types
 - Web servers, databases
 - Custom business apps
 - Search clusters, data mining

Challenges: large scale and dynamic workload fluctuations



Server Virtualization

- Data centers use virtualization to share physical resources and simplify automation
- Allows a server to be “sliced” into Virtual Machines
- VM has own OS/applications
- Rapidly adjust resource allocations
- VM migration within a LAN

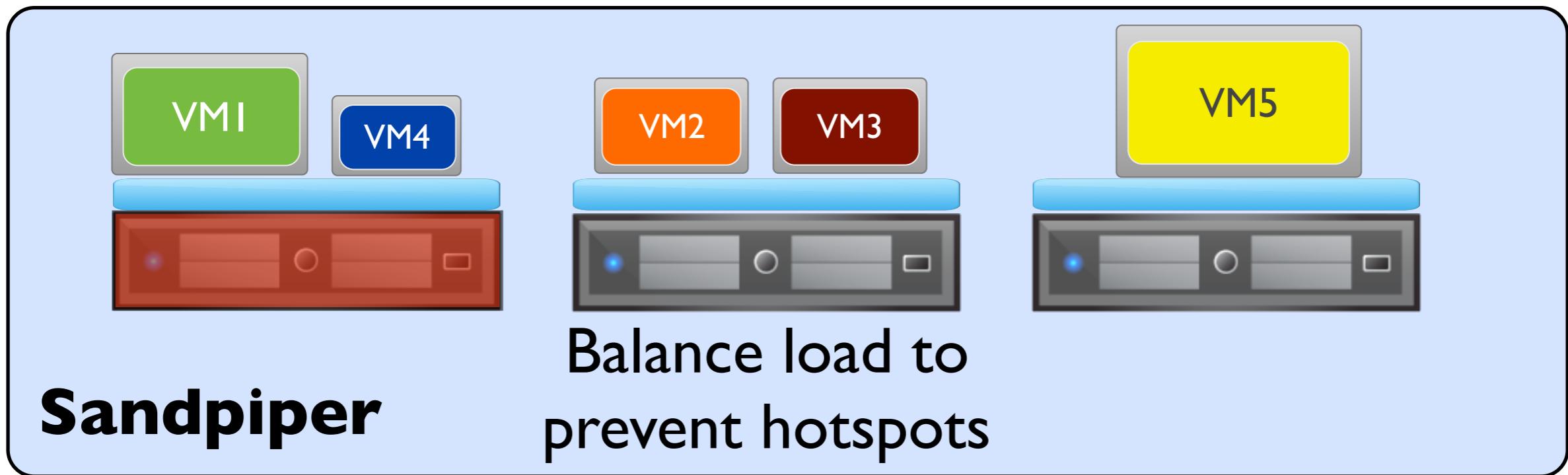
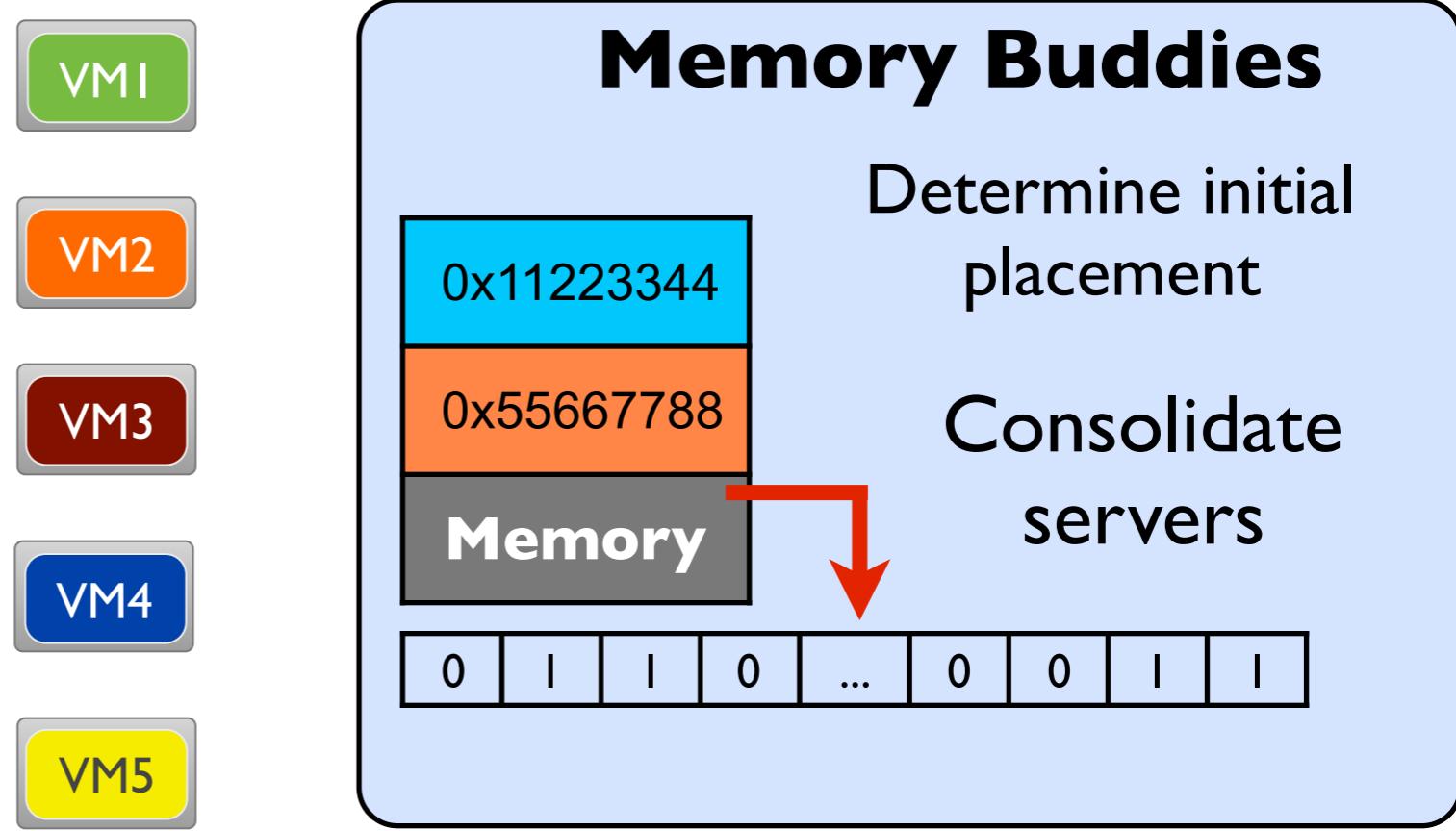
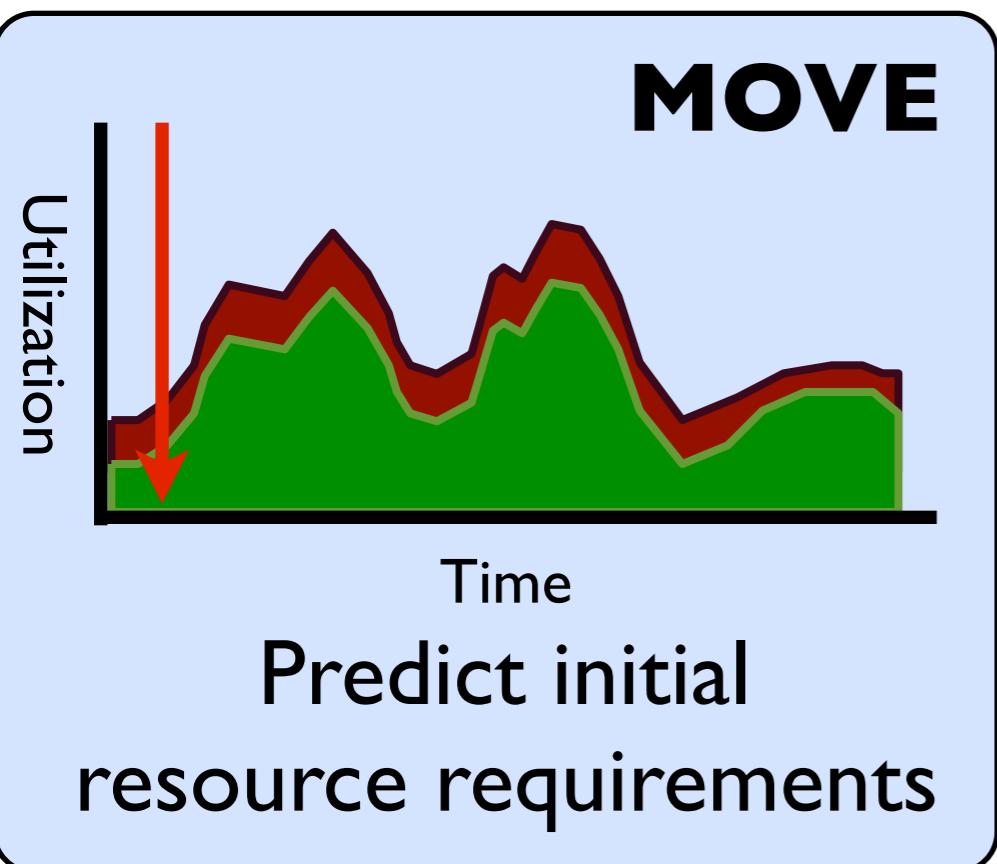


Within a Data Center

- How to transition applications to VMs and account for virtualization overheads?
 - **MOVE**: Modeling Overheads of Virtual Environments
- Where should VMs be placed to allow for the greatest level of server consolidation?
 - **Memory Buddies**: Memory sharing guided placement
- How to dynamically allocate VM resources to prevent server overload?
 - **Sandpiper**: Automated VM migration and resizing



Within a Data Center



What is good in these slides?

What is good in these slides?

Good balance of text and visuals

Nice high level overview of thesis

Good connections between components of thesis

Animation is a bit excessive

Slide Tips



US Wireless Market – Q2 2010 Update

What to expect in the coming months?

31% of the US subscription base is now smartphones.

The pace of product introduction is accelerating with each quarter. Devices of all shapes and sizes are coming into the market literally every week. Players are having to re-evaluate their businesses and long-term strategies. Several new impressive devices got introduced during the course of 1H of 2010 including the iPad and EVO.

There are several players whose future is at stake (to put it mildly). The competition has grown fierce and companies are finding it hard to take ideas from R&D to products in market in a short amount of time.

Microsoft announced its comeback with the W7 commercial launch imminent. The change in UI was refreshing and the expectations are quite high. W7 v2 is likely around the corner to update on the flaws of v1. HP acquired Palm in an attempt to become relevant again in the mobile device space. It has been an action packed 1H 2010 and we can expect more of the same for the remainder of the year.

2010 has also been active on the regulatory front as the national broadband plan was unveiled in March and the subsequent debate over the course of nations broadband future kept the spectrum, net-neutrality, and exclusivity issues at the forefront.

To start planning for 4G, 5G, and beyond, US should think about rolling a 50 year broadband plan. While more spectrum is always helpful, will we have all the spectrum we need in 2050? or do we need to invent new technologies and business models that use spectrum more wisely? This topic will keep the industry occupied for some time to come. (We will be going in-depth into this subject at our Sept event with some very senior and experienced executives)

2010 is also the year of network rollouts. T-Mobile has been rolling out HSPA+ at an impressive rate, Clearwire announced its intention to move to LTE, Verizon is betting big on LTE and looking for competitive marketing advantage over the course of the next 12 months. AT&T has been adding backhaul, upgrading to HSPA+ and planning for LTE all at once. Even the smaller carriers like MetroPCS are looking for competitive advantage with quicker LTE launch and beat others by carrying the first LTE smartphone. (We will be releasing the next edition of our "State of the "Mobile" Broadband Nation" paper later this year)

As we had mentioned last year, the mobile data traffic kept on growing disproportional to the revenues. A series of solutions have come into the market from players big and small. We released the second edition of our in-depth research paper on data growth - "Managing Growth and Profits in the Yottabyte Era" last quarter.

We will be keeping a very close eye on the micro- and macro-trends and reporting on the market on a regular basis in various private and public settings.



Limit your text (84 point)

Use large fonts (41 point)

- Not smaller than this (32 point)

Use bullets, not paragraphs

- **Emphasize** your key points

Don't try to be exhaustive

- Unless the slides will be referred to later without your speech

Don't try to cram in too much content!

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Mix Text and Images

Microboxes: High Performance NFV
with Customizable, Asynchronous TCP
Stacks and Dynamic Subscriptions

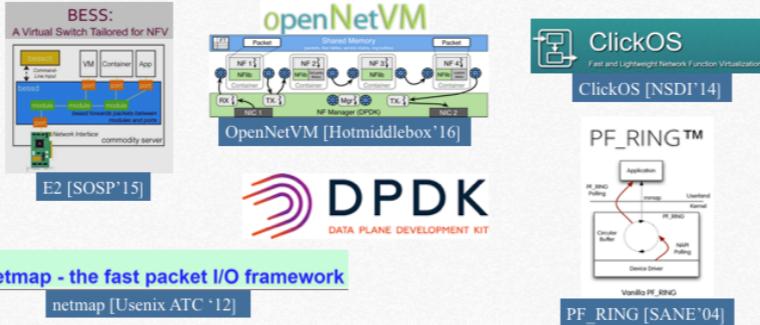
Guyue (Grace) Liu, Yuxin Ren, Mykola Yurchenko
K.K. Ramakrishnan, Timothy Wood



E2 [SOSP '15]

Why Improve Existing NFV Frameworks?

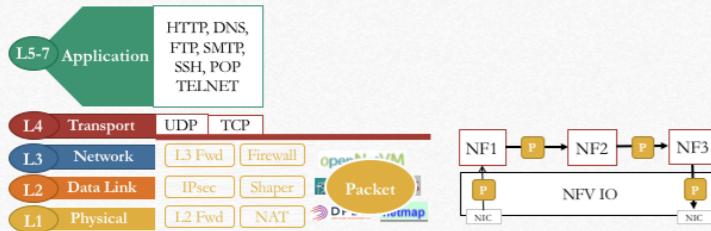
- Existing NFV frameworks focus on L2/L3 processing



1

Why Improve Existing NFV Frameworks?

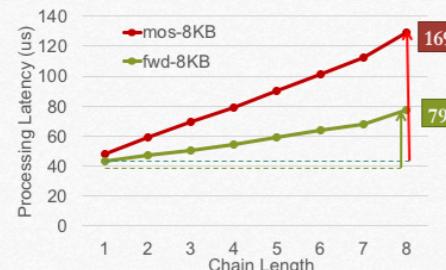
- Existing NFV frameworks are based on a packet-centric model



4

Issue #1: Redundant Stack Processing

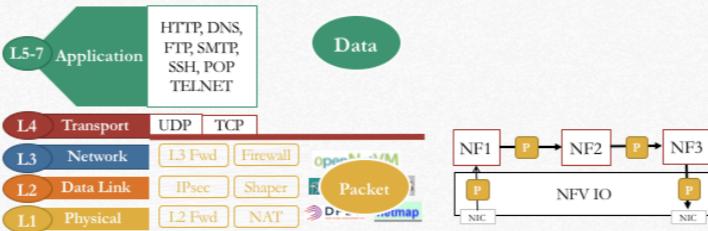
- As the chain length increases, the overhead grows significantly when going through stack processing multiple times



7

Why Improve Existing NFV Frameworks?

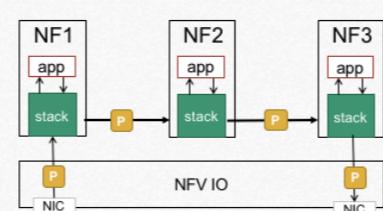
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5

Idea #1: Consolidate Stack Processing

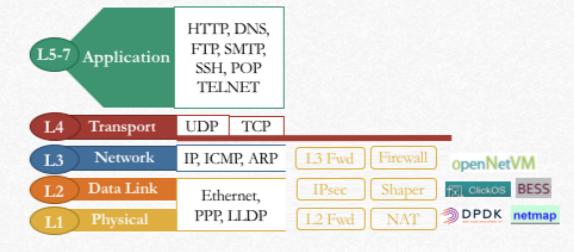
- How can we remove the redundancy within a chain?



8

Why Improve Existing NFV Frameworks?

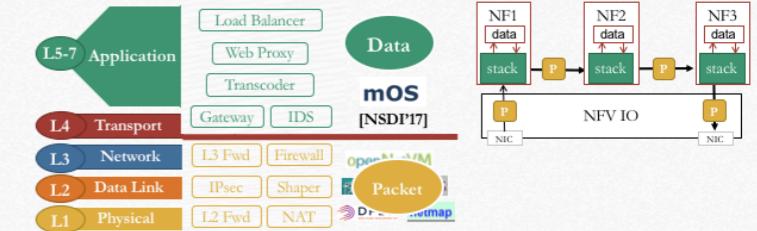
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3

Why Improve Existing NFV Frameworks?

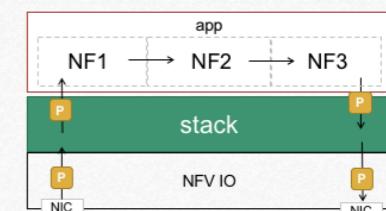
- Existing NFV frameworks are based on a packet-centric model
- Protocol processing becomes part of the NF. Repeated protocol stack processing within a chain - redundant



6

Idea #1: Consolidate Stack Processing

- How can we remove the redundancy within a chain?
- Deploy all NFs and the stack as a single, **monolithic process**?



9

USE A HIERARCHY

- This is text
 - This is also text
 - This is even more text
 - Why are they all the same size?

Use a hierarchy

This is text

- This is also text
 - This is even more text
- Note that they are not the same size!

White space is important, but **Keynote is absurd**

- And sub bullets with a smaller font size help viewers focus on key points

Make your own template
and keep improving it!

USE A HIERARCHY

- This is text
- This is also text
- This is even more text
- Why are they all the same size?

GW PPT Template

This is where I put my content

Here is more content

Wow, this is just awful.

Why is the bar so big at the bottom?

I have so little useful space and it is poorly laid out.

My Template

Text that is reasonably large

- Sub bullets that are smaller
 - Sub-sub bullets that are even smaller, although I rarely use them
 - (Mainly so I can add spacing more flexibly)

Large “before paragraph” spacing so bullets aren’t too tight and smaller line spacing so you can fit denser text when needed (try to avoid multi-line)

A useful footer with your name and affiliation

- Always include the slide number in corner!

Minimal background images

Optional: school / lab logos

**Pop up boxes to emphasize
key points!**

Should we animate?

Text that is reasonably large

- Sub bullets that are smaller
 - Sub-sub bullets that are even smaller, although I rarely use them
 - (Mainly so I can add spacing more flexibly)

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Minimal background images

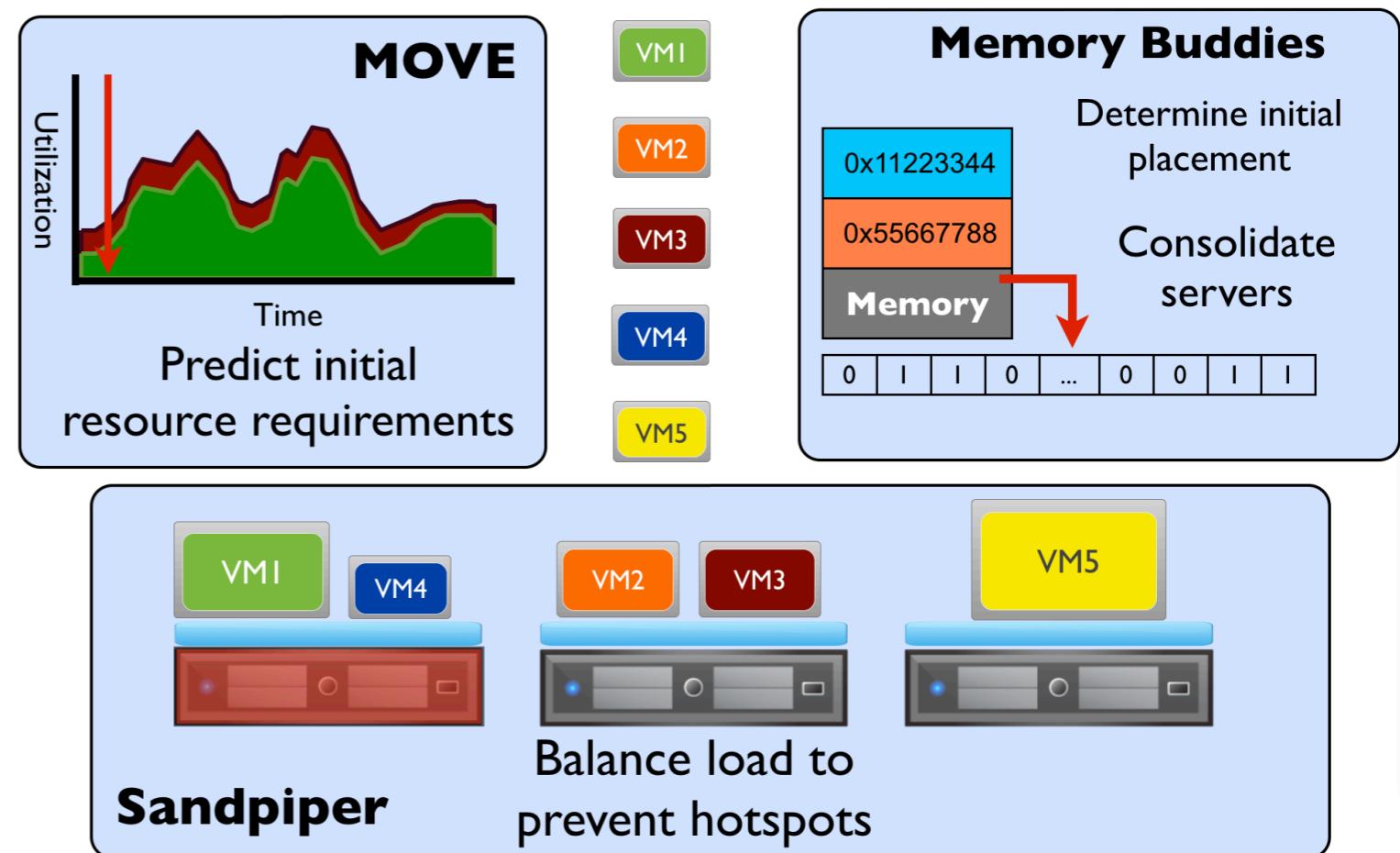
Optional: school / lab logos

**It depends! Usually only if
~3 bullets on slide**

Animations

Useful, but “expensive” to create

Can be distracting if overused



Suggestion: only use animation for emphasizing most important points

- And you only have at most 3 of those, right?

Color Inspiration



Fig 2

A screenshot of the NCSA website. The header is blue with the NCSA logo and navigation links. A sidebar on the left is yellow with sections for "NCSA News", "Feature Stories", and "Events". The main content area features a search bar and a banner for "Searching for Vis and VR".

Fig 3

A screenshot of the NCSA website showing a different layout. It includes a purple sidebar with "NCSA NEWS" and "Feature Stories", and a blue footer with copyright information.

Fig 4

From Boxes and Arrows



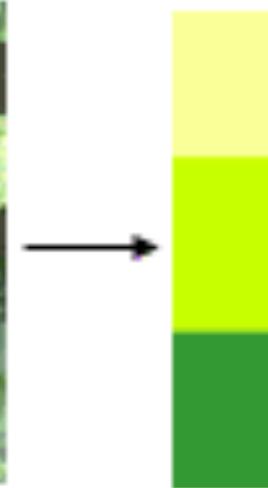
Fig 7

Color

Related colors



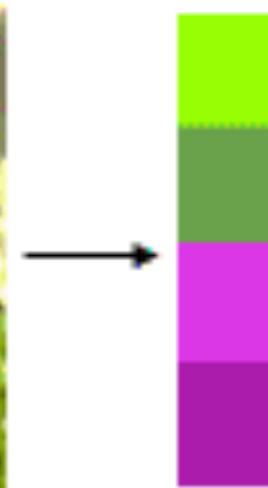
©Jill Morton - Color Matters



Complementary colors



©Jill Morton - Color Matters



Limit the number
of colors

Max per display: 4

Max across entire
app: 7

Font/Background Color

White background with a black font is easier to read

Black background with white font can look childish

Other colors may not have enough contrast or could look strange depending on the projector

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Fonts

Know the difference between:

Serif fonts: easier to read in print

- Times New Roman

Sans-Serif fonts: more modern on screen

- Arial, Helvetica

Monospaced fonts: only for code

- Courier

Never use Comic Sans!

Ted Talk style?

Should we mimic TED talk slide style?

PREPARING TO FAIL

Photo: Blair Harkness

PEOPLE

CODE

INFRASTRUCTURE

INFRASTRUCTURE

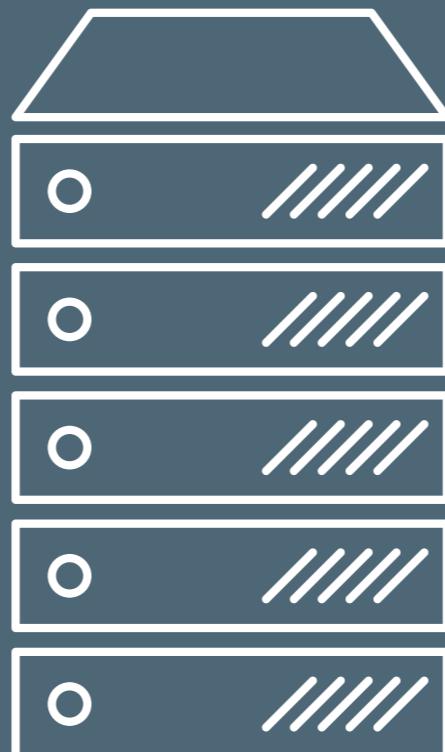
“Success is stumbling from failure to failure with no loss of enthusiasm.”

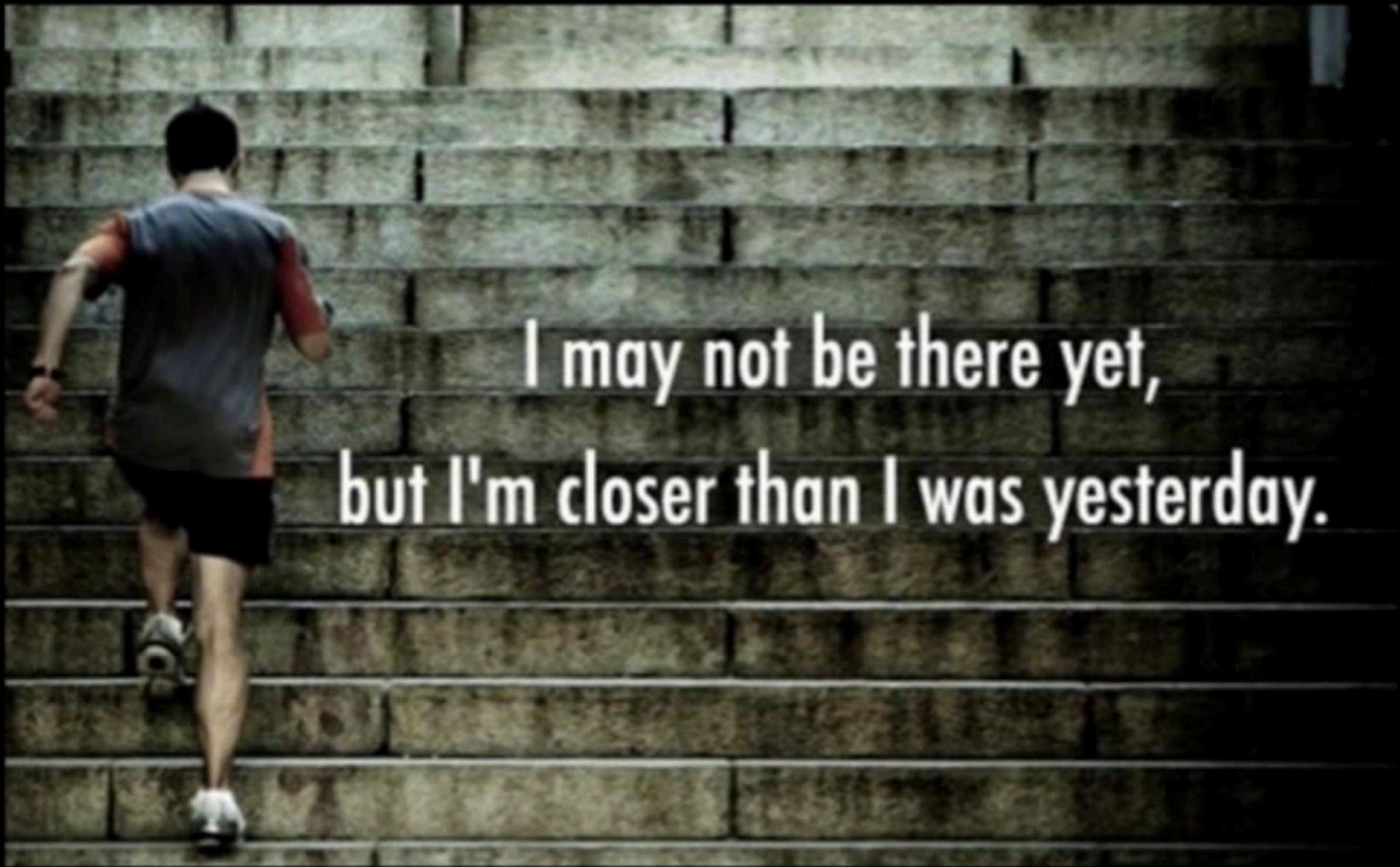
WINSTON CHURCHILL

REDUNDANCY



MULTIPLE HARD DRIVES





I may not be there yet,
but I'm closer than I was yesterday.

TED Slide Style

Don't use this for a technical talk

TED is great inspiration for **speaking** style

- but the slide format is mainly relevant for “motivational” talks

Similarly, much of the advice for making great slides online is not relevant!

- They are for a business audience!

Know your audience!

Slide format will be very different...

Classroom tutorial

- lots of text, slides need to be able to stand on their own

Talk at CS conference

- Precise, technical material. Mix of text and visuals

Pitching a startup or product

- Focus on excitement and innovation, advertising not science

Talk at Department of Defense

- They love text heavy slides for some reason...

Each company / org will have its own “culture”

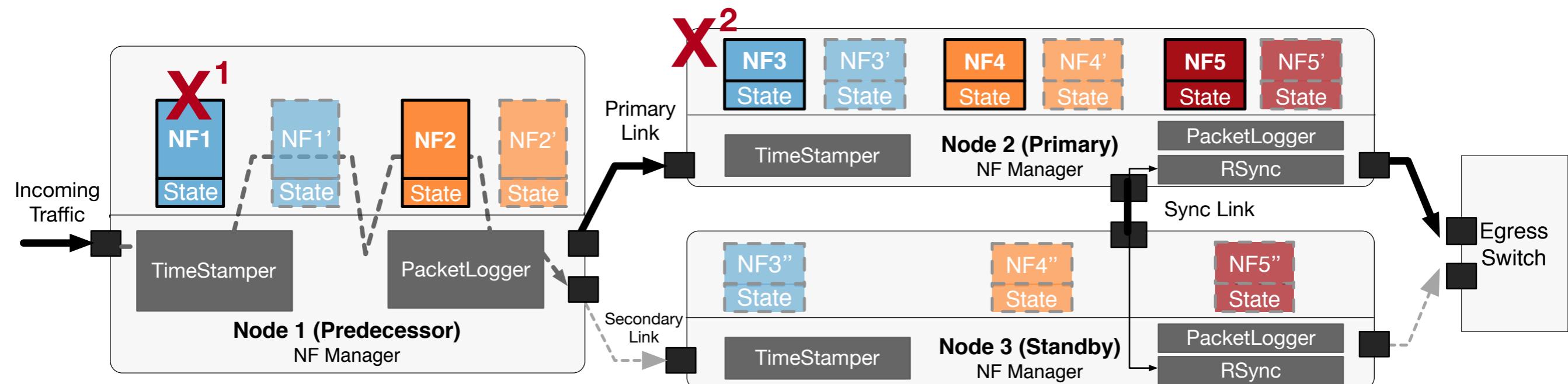
Diagrams and Graphs

Tips

Diagrams

Visual representations of your algorithm, system, or approach are always helpful

- Make the paper easier to understand
- Break up large chunks of text



Find a tool that works for you

- My lab uses Omnigraffle (mac only)
- Use something consistently so you become more efficient

Bad Diagrams

Is this a good system diagram?



Common Problems

Useless content

Bad color choices

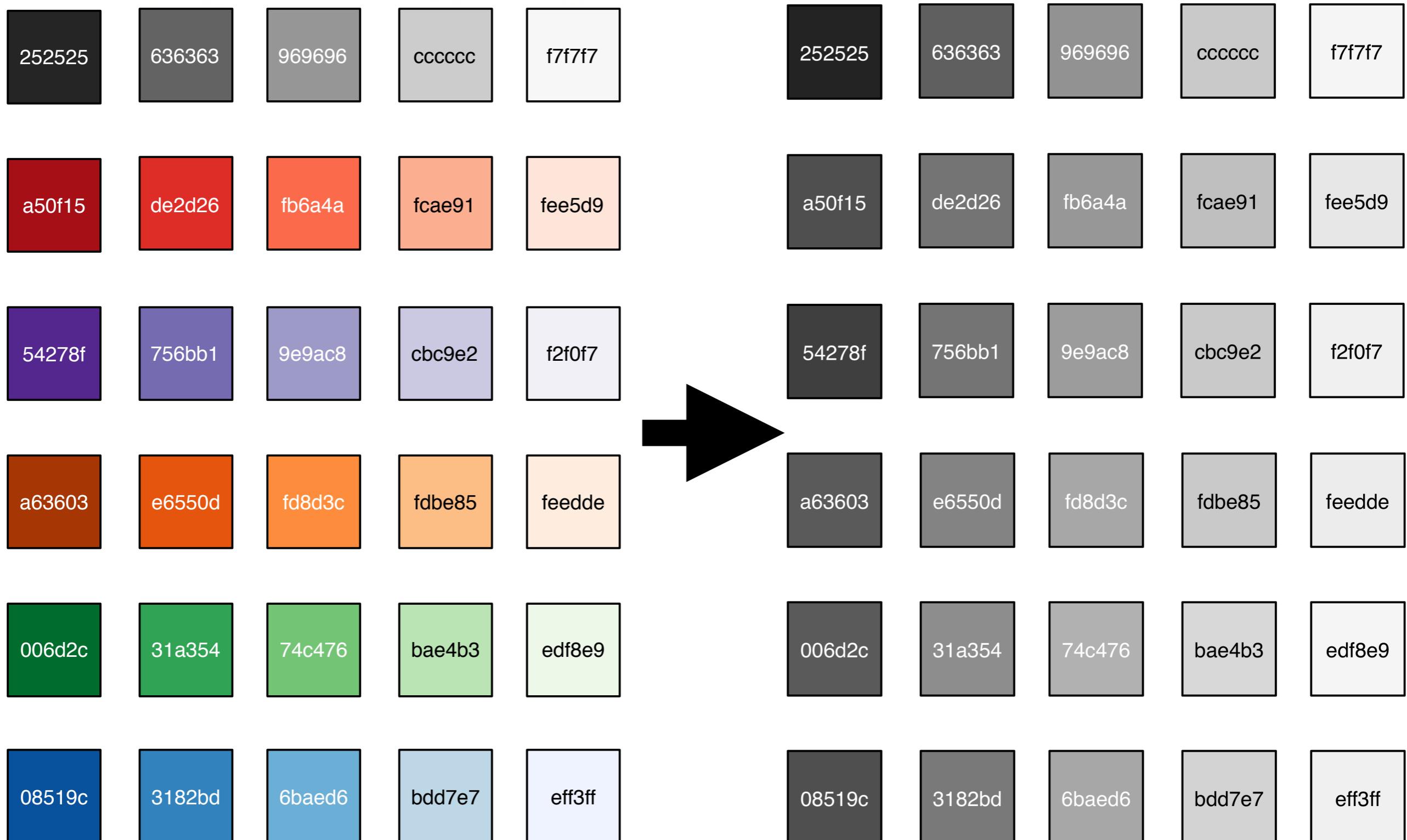
- Indistinguishable, childish, etc

Fonts need to be bigger!

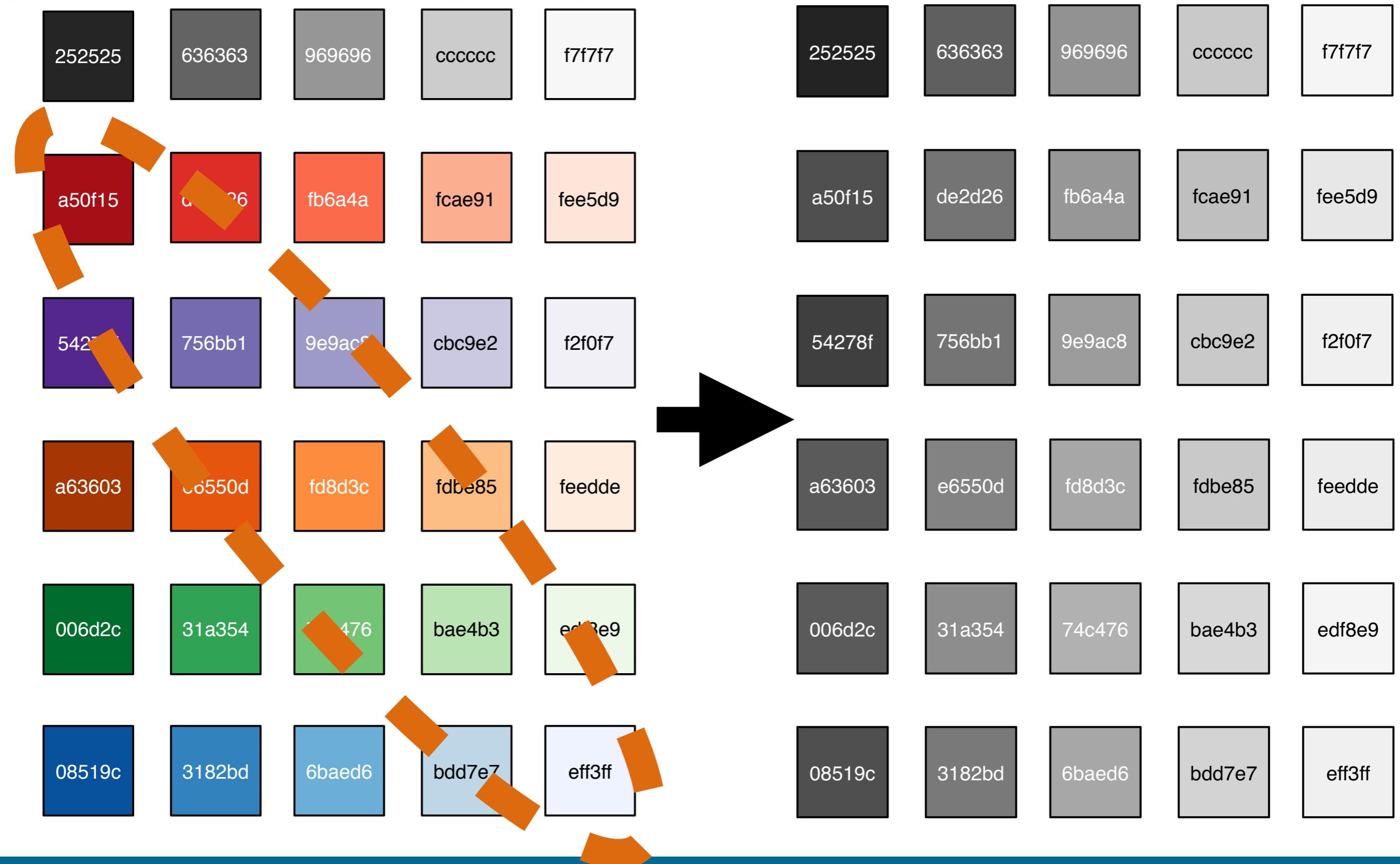
No caption to explain

- I prefer useful captions instead of “title” captions

Color to BW



Color to BW



Let's make a diagram...

Goals:

Clean, consistent shapes

Clear connections between components

Useful colors

Looks good in print

Graphs

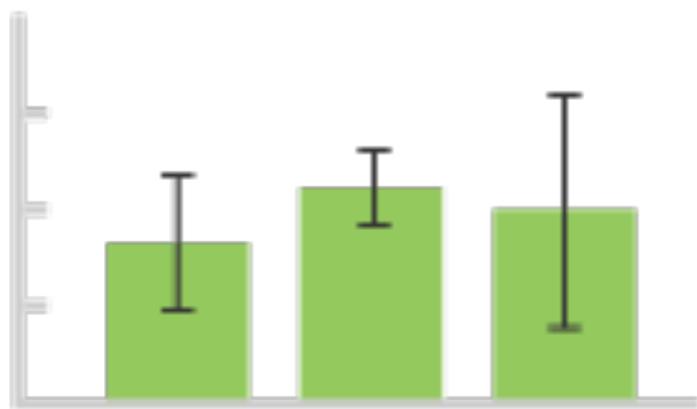
Stick with “standard” graph types

- Unless you have a good reason
- Standards: Scatter plot, line plot, bar plot
- Avoid pie charts and “infographic” look

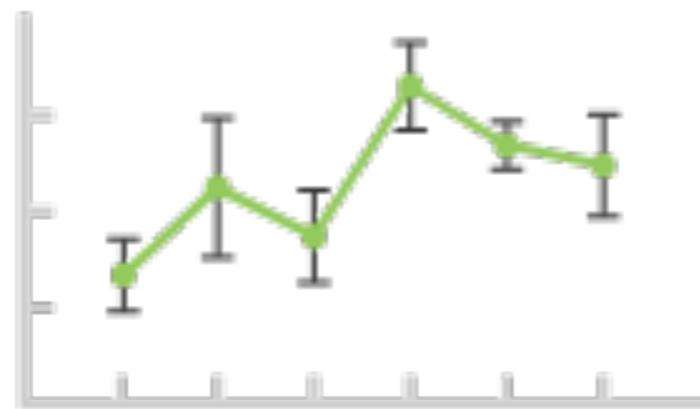
Include error bars!

- Use standard deviation or confidence interval

Bar Chart



Line Graph



Every graph in this paper was a radar chart... odd

Graphs

What tool do you use to make plots?

- gnuplot, matplotlib, seaborn, tableau, matlab, R...

Avoid tools like Excel

- Most papers I review with Excel graphs I reject (not usually because of the graphs, but it is a sign of amateur-ness)

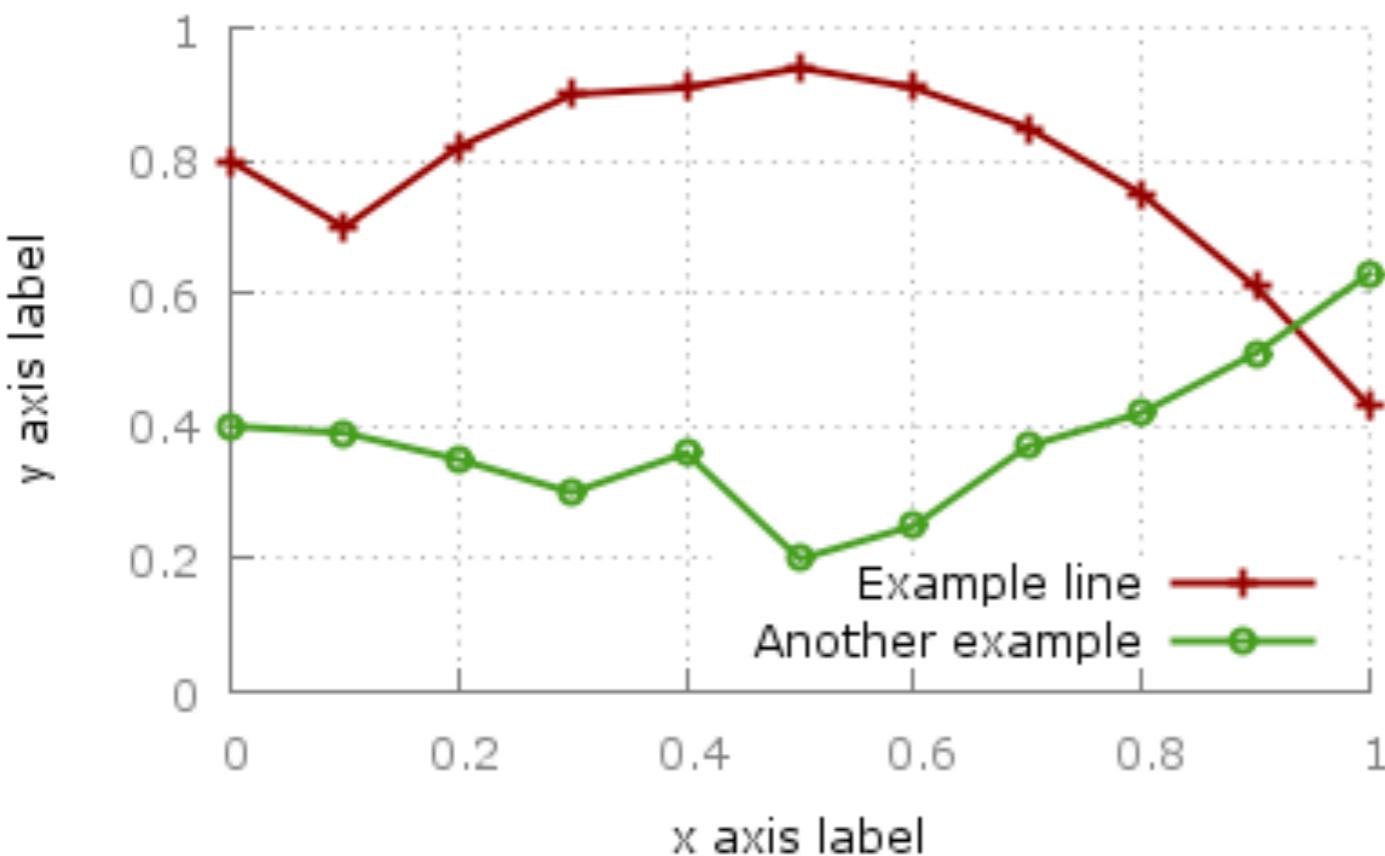
Use the same tool as your lab-mates

- Have lab scripts for making beautiful graphs

Graph Tips

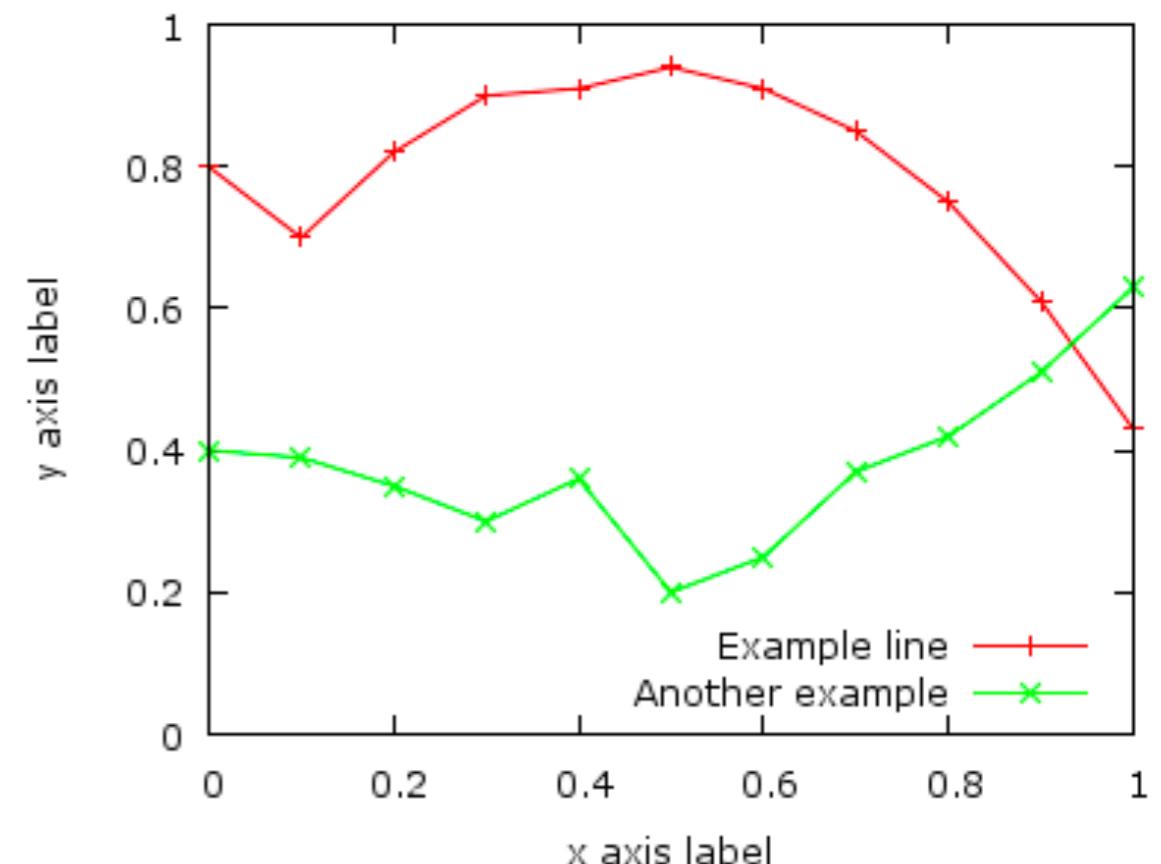
Use:

- Thick lines
- Very large fonts
- Axis labels
- Wide format



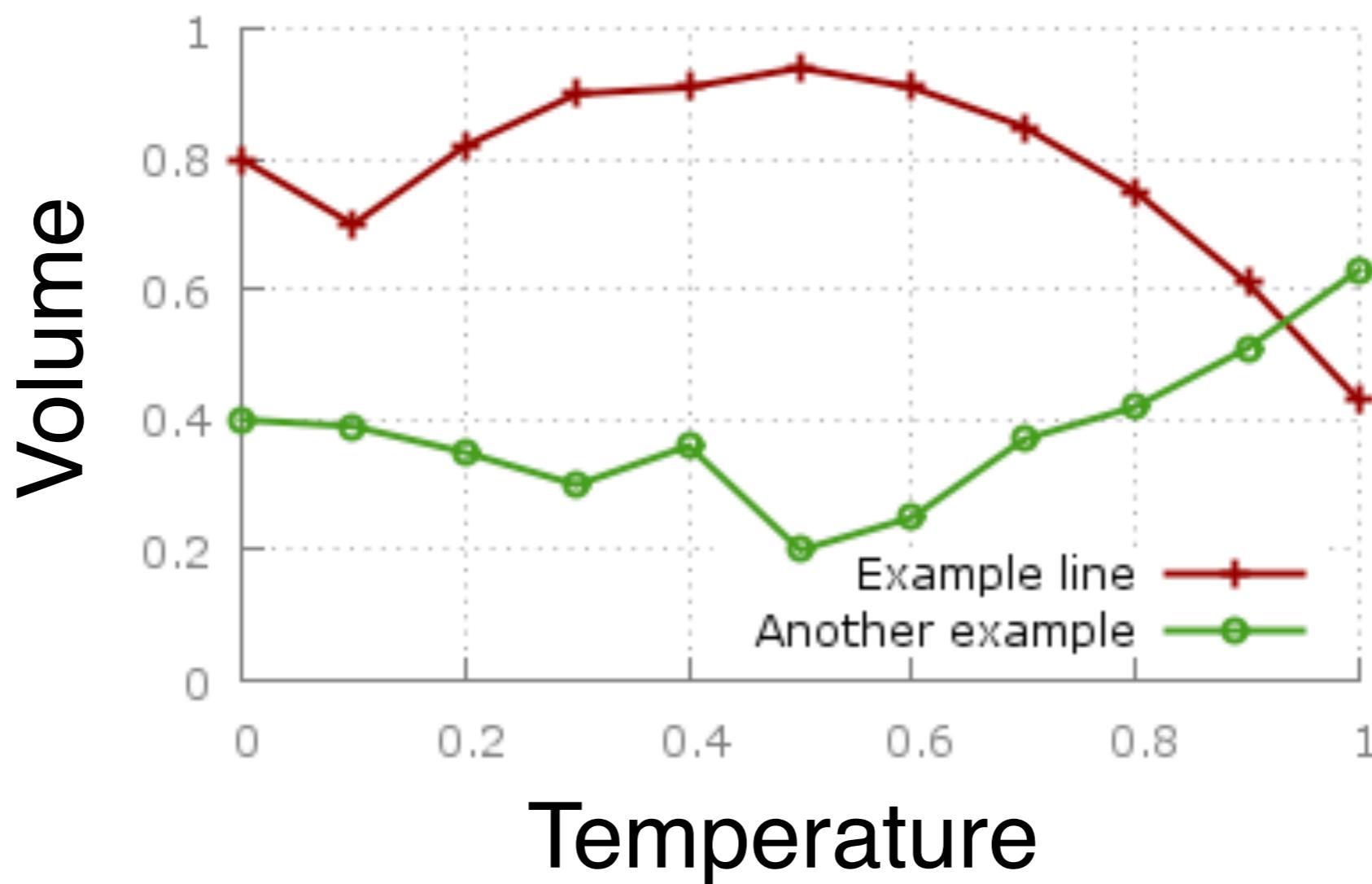
Avoid:

- Similar colors (check BW!)
- Non-0 starting axes
- Titles (if you have caption)
- Square aspect ratio



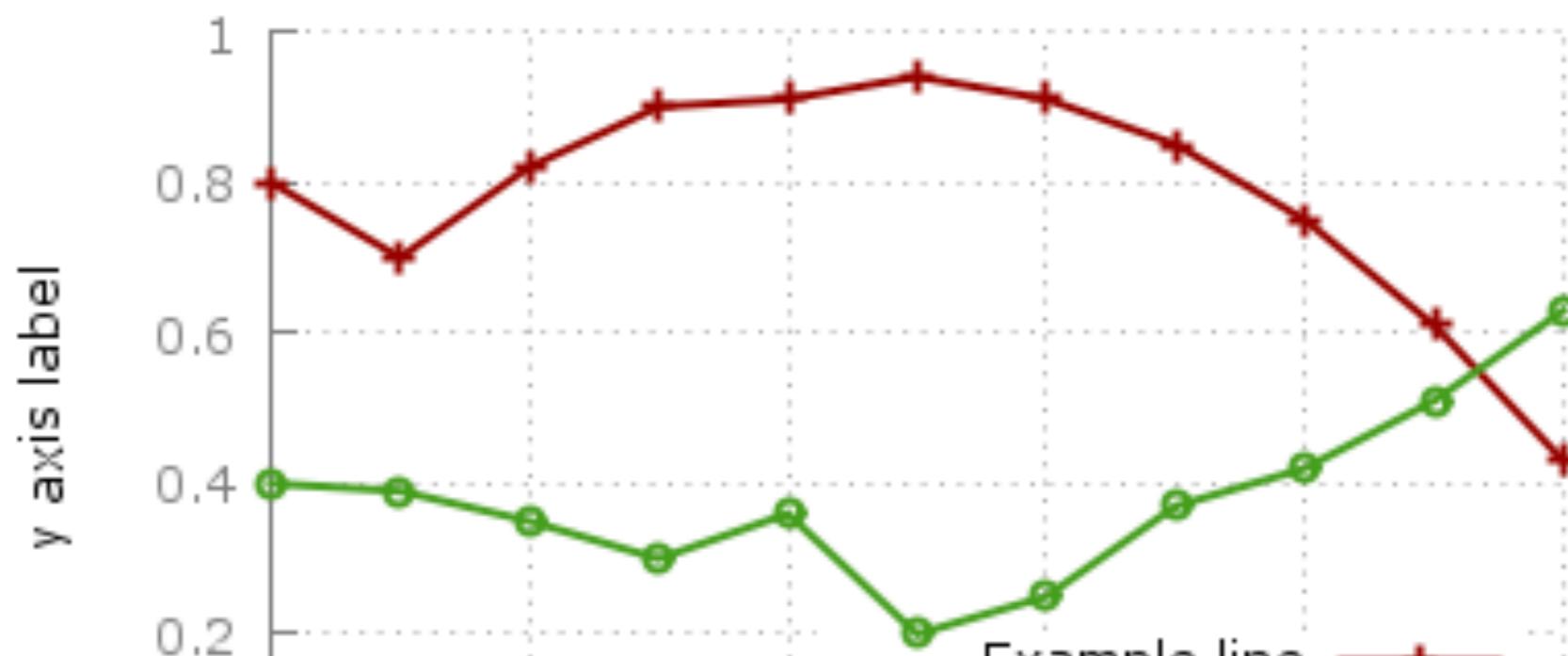
Line Graphs...

My high school science teacher would (correctly) fail me for making this graph... why?



Line Graphs...

My high school science teacher would (correctly) fail me for making this graph... why?



“Connect the dots” is really unscientific!
Trend lines are way better!

But this is what the community expects!

Accessibility

Color blindness

- 1 in 12 men, 1 in 200 women



THE AMERICAN FLAG
AS SEEN

I-BY MOST PEOPLE
II-BY RED-BLIND PERSONS
III-BY GREEN-BLIND PERSONS
IV-BY VIOLET-BLIND PERSONS
V-BY TOTALLY COLOR-BLIND PERSONS

Accessibility

Color blindness

- 1 in 12 men, 1 in 200 women

Blindness

- about 8 million people in the US have a visual disability

Many types of disabilities to be aware of: sight, sound, touch, mobility



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Visual Recipes

Slides:

- Mixture of text and images
- Keep bullets simple, fonts clear
- Use animation sparingly for emphasis

Diagrams:

- Pick the right level of abstraction; focus on relationships
- Use LARGE fonts!
- Be sure colors work in B&W

Graphs:

- Use easy to understand plot types
- Use thick lines and be sure they are distinguishable
- Use LARGE fonts!
- Be sure colors work in B&W