How to make a more effective research poster

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November 2015

*Created as **reference material** for MIT's 6.UAR course:*
"Preparation for Undergraduate Research"

With reference examples courtesy of the 2015 students

Use this as a reference...

to fix up your poster

Topic	Slides
Decrease text	3-11
Structure text	12-20
Adapt content to the non-expert	21-25
Tell a story	26-29
Add more figures	30-38
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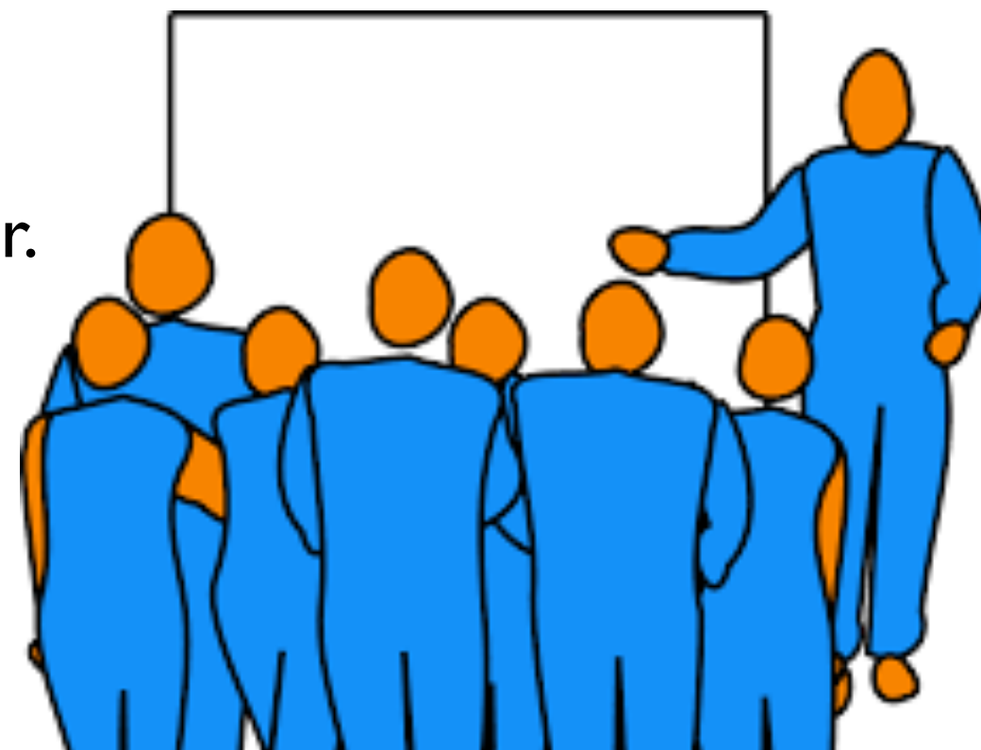
Decrease text

Leave the wordiness to the talking

- Full sentences are for presentations, not posters.
- A poster session is a discussion. If the poster is self-explanatory, people will not engage in a discussion with you.
- You do not want to read or recite word-for-word what is on your poster, so leave the details and explanations to the presentation, not the poster.
- Whatever text you have on your poster can be probably be said shorter.



Introduction

Motivation

The overall goal of the project is to learn more about the brain, specifically human memory, through various memory tests.

In this project we present a combination of tested and new techniques for experiment administration. We plan to gather demographic and personality information about out users, to gain further insights about human memory.

Objectives

The main objective of this Super UROP is to write an Android application to serve as another means for experiment administration

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There is no point in having a poster if all you have is text. Leave the paragraphs for your papers.

Common shortcoming:
crowding a poster with text... especially in full-sentence form... especially in paragraphs.

Solution: pick only the most important points, use bulleted lists where appropriate, balance text with figures.

BETTER:

Introduction

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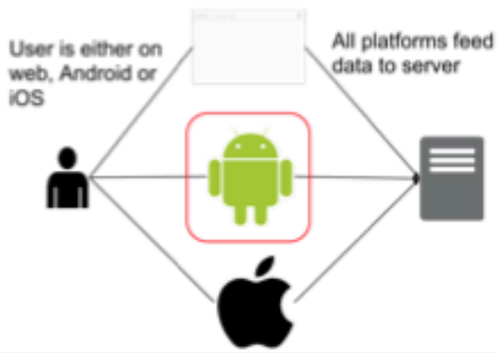
The main objective of this Super UROP is to write an Android application to serve as another means for experiment administration

Introduction

Motivation
Gain insights about human memory by
- Using memory tests in new experimental platforms
- Gathering demographic and personality information

Objectives
Develop an Android application to serve as a new experimental platform



- Text like: "in this project" adds extra fluff without adding content. It is self-evident that your poster is about your project.

Less text... even less

Previous	**Better**
Remy has been shown to perform better than other human engineered algorithms.	
Combining these two technologies, two systems were created that can produce 2D and 3D microfluidic channels with precise cell placement.	
Design a deep neural network based system to automatically extract features.	

- Which words do not add much extra meaning?
- Is there redundancy you can eliminate?
- Is there a shorter way to say the same thing?

Less text... even less

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Remy has been shown to perform better than other human engineered algorithms.	Remy performs better than human engineered algorithms.
Combining these two technologies, two systems were created that can produce 2D and 3D microfluidic channels with precise cell placement.	Using these technologies, we created systems to precisely place cells in 2D and 3D microfluidics.
Design a deep neural network based system to automatically extract features.	Design a deep neural network to automatically extract features.

- Which words do not add much extra meaning?
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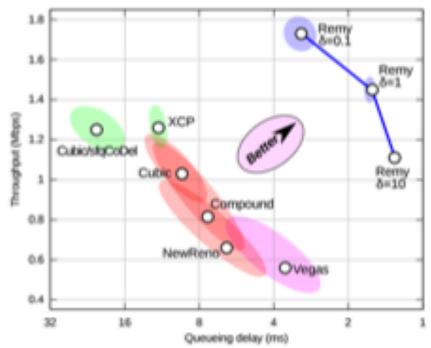
Background: Remy

- Remy is a computer program that produces congestion control protocols based on input parameters



- In simulation with **ns-2**, Remy has been shown to perform better than other human engineered algorithms

http://mit.edu/remy/TCPexMachina.pdf

BETTER:

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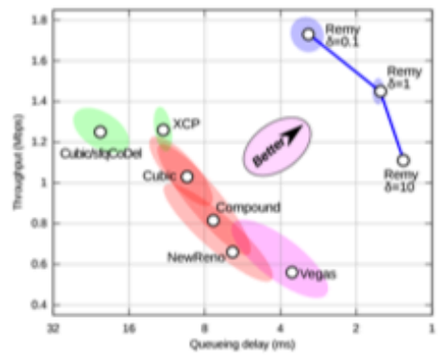
- Computer program that produces congestion control protocols



- In simulation with ns-2, Remy protocols perform better than many human engineered algorithms

http://mit.edu/remy/TCPexMachina.pdf

- Headings add to the amount of text on your poster.
- Use this text wisely, and do not introduce extra redundancy.

example courtesy of Deepti Raghavan

BETTER:

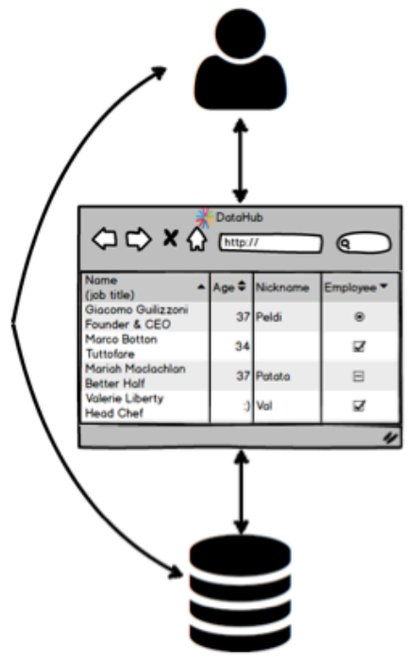
Background and Motivation

Motivation:

- Current data systems focus on scalability and power but not on user experience.
- These systems are built for data scientists and programmers; some background knowledge on the system and internal infrastructure is required.

Solution:

- DataHub – A hosted platform for storing data in a sharable, easily modified and queried space.



The user can choose to interact with the data directly or through the user-friendly DataHub interface.

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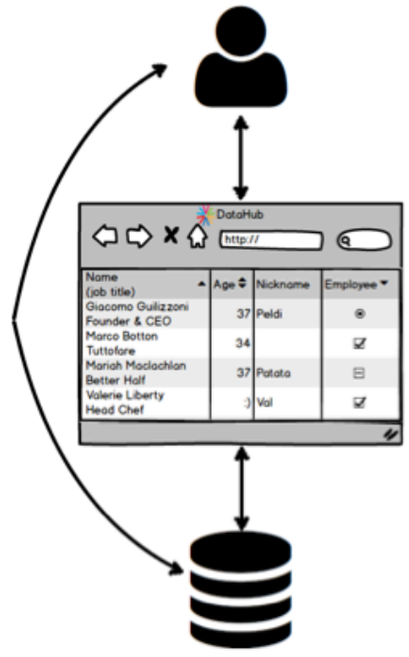

The user can choose to interact with the data directly or through the user-friendly DataHub interface.

- Meaningful headers help to guide the logical flow of the text.

example courtesy of Kimberly Leon

Structure text

Options for structuring text

- Convert full sentences to bullet form: easier to navigate at-a-glance
- If multiple separate sentences/bullets in a row have a similar structure (e.g. cause -> effect, device -> measurements, object -> properties), can use a table to make the repeated structure/ relationship explicit/clear

term 1	definition
term 2	definition

method 1	advantages
method 2	advantages
method 3	advantages

object 1	properties
object 2	properties
object 3	properties
object 4	properties

- Emphasize (**bold**, color, highlight) the key terms or phrases, so the viewer's eyes can stop on them and jump straight to them

Why should you structure text?

- Reading a bulk of text at once requires sustained attention
- **People are not very good at sustained attention**... especially at crowded poster sessions
- Make it easier for the viewers. **Direct their attention to the parts of the text that matter.**
- Let the most important terms and concepts pop out.
- If the viewer has limited time (or gets distracted), they should still be able to determine what the poster is about and potentially extract the most important concepts.

Problem

Existing magnetizing machine operated with lead-acid batteries. Lead-acid batteries have a relatively high energy density and a low power density. Several batteries were needed to achieve the necessary power, increasing the total energy stored to an unsafe level

Specific Energy: $35-40\ \frac{Wh}{kg}$ [1]

Specific Power: $\sim 400\ \frac{W}{kg}$ [2]

[1] Ultralife Corporation, Li-Ion vs. Lead Acid
[2] C&D Technologies, UPS12-270 Datasheet

BETTER:

Problem

Existing magnetizing machine operated with lead-acid batteries.

<u>Lead Acid Batteries</u>

low power
high energy

Unsafe: many batteries needed, high energy

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Specific Power: $\sim 400\ \frac{W}{kg}$ [2]

[1] Ultralife Corporation, Li-Ion vs. Lead Acid
[2] C&D Technologies, UPS12-270 Datasheet

- Restructuring the text helps break the content down into more digestible components.

example courtesy of Eric Dahlseng

PROBLEM:

- Many current congestion control algorithms respond to packet loss by **reducing the rate** at which packets are sent
- Packet loss is **not always** caused by congestion (could have loss from attacks)

The emphasized text is what the viewer/reader will most likely pay attention to and take-away.

Common shortcoming:
emphasizing the wrong part of the message.

Solution: leave emphasis for key terms and properties, not connecting words.

example courtesy of Deepti Raghavan

PROBLEM:

- Many current congestion control algorithms respond to packet loss by **reducing the rate** at which packets are sent
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BETTER:

PROBLEM:

- Current congestion control algorithms respond to packet loss by **reducing rate** at which packets are sent
- **Packet loss** not always caused by congestion (could have loss from attacks)

example courtesy of Deepti Raghavan

Use tables to more concisely convey information

Current Experiments	Expected Outcome
Train RemyCCs with finite buffers, no change in signals	Performance without accounting for loss (with current state signals)
Train RemyCCs with additional state signal that accounts for loss directly	Performance when using loss as a primary congestion signal
Look for and train with additional signals to account for loss	Performance while accounting for loss not directly
Look for and train with different objective functions	With right objective function, maybe we do not need to account for loss at all!

example courtesy of Deepti Raghavan

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BETTER:

Experiments	Expected Outcome
Infinite buffers, current signals	Current performance, ignoring loss
Finite buffers, extra signal to track loss **explicitly**	Performance under explicit loss tracking
Finite buffers, **different, implicit** signal to account for loss	Performance under implicit loss tracking
Different objective functions	Performance under different objective, ignoring loss

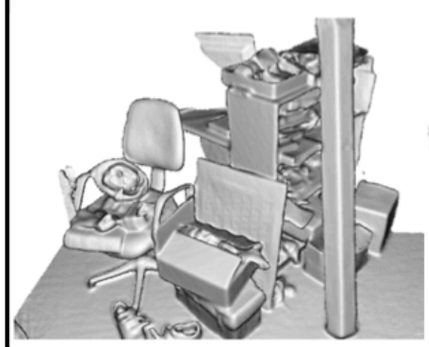
- Use the structure afforded by the table to help cut down on text within each cell (can remove redundancy!).

example courtesy of Deepti Raghavan

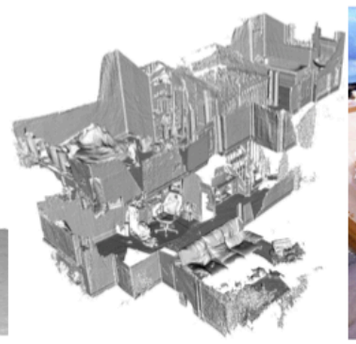
Tables can be more effective than bullet points

(if used appropriately)

Previous Dense Visual SLAM Techniques



KinectFusion [1]



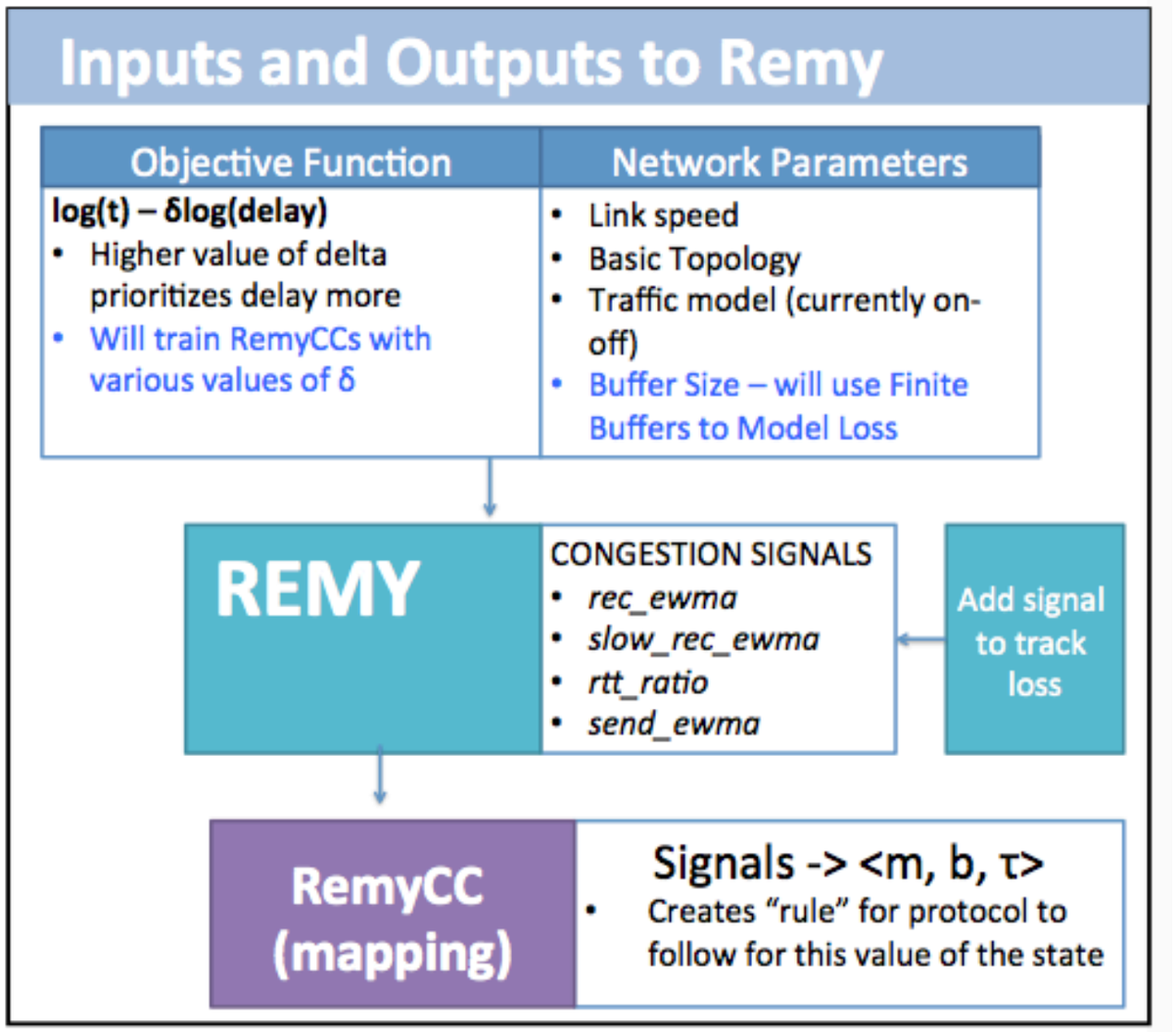
Kintinuous [2]

ElasticFusion [3]

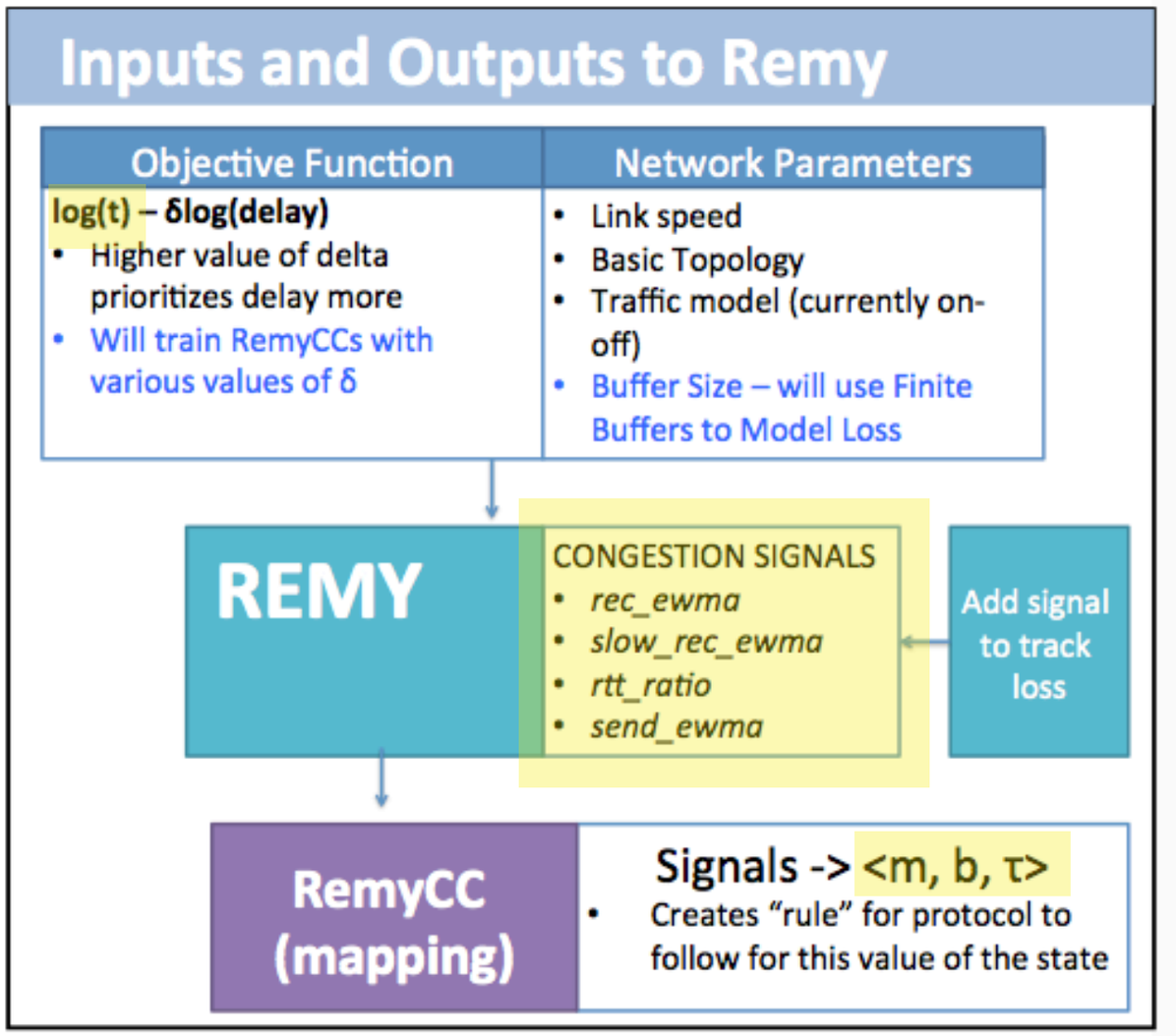
	Dense Map	Large Scale	Surface-Model Loop Closure
Kinect Fusion	✓	✗	✗
Draper's System	✓	✓	✗
Kintinuous	✓	✓	✗
Elastic Fusion	✓	✓	✓
SuperUROP	✓	✓	✓

example courtesy of Vincent Kee

Adapt content to the non-expert



example courtesy of Deepti Raghavan

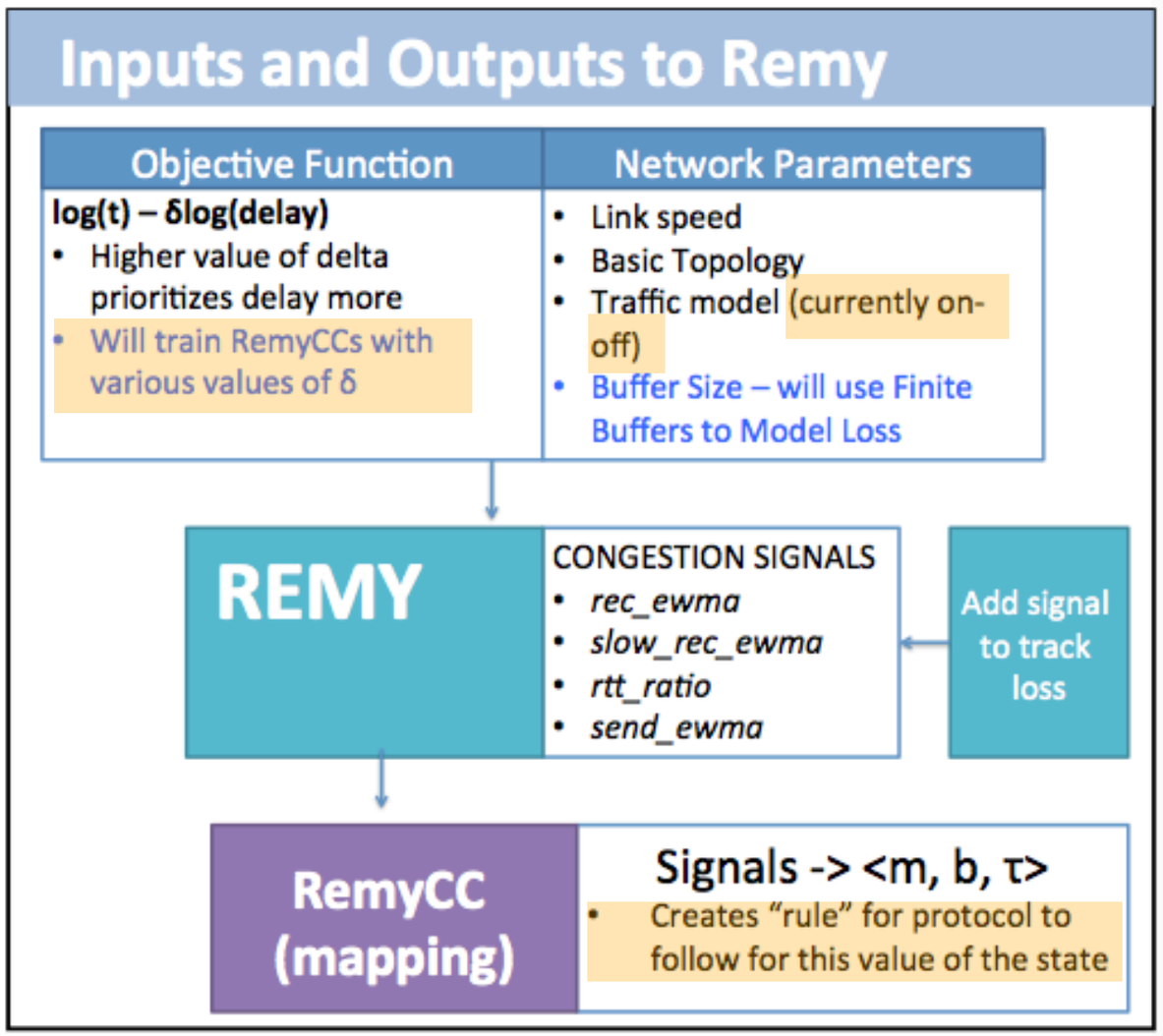


None of the symbols highlighted will be known/obvious to a non-expert in this system.

Common shortcoming:
putting implementation details in the terms you're used to thinking about them on the poster. Forgetting to step back and give the viewer the important high-level picture.

Solution: translate into terms others can quickly grasp.

example courtesy of Deepti Raghavan



Are the highlighted details absolutely essential to have on the poster?

Common shortcoming:
putting implementation details that are not absolutely essential on the poster.
Crowding the high-level picture with less important details.

Solution: leave the high-level, say the rest in words (if the listener is interested).

example courtesy of Deepti Raghavan

BETTER:

Inputs and Outputs to Remy

Objective Function	Network Parameters
log(t) – δlog(delay) • Higher value of delta prioritizes delay more • Will train RemyCCs with various values of δ	• Link speed • Basic Topology • Traffic model (currently on-off) • Buffer Size – will use Finite Buffers to Model Loss

REMY

CONGESTION SIGNALS
- *rec_ewma*
- *slow_rec_ewma*
- *rtt_ratio*
- *send_ewma*

Add signal to track loss

RemyCC (mapping)

Signals -> <m, b, τ>
- Creates "rule" for protocol to follow for this value of the state

Remy Workflow

OBJECTIVE FUNCTION	NETWORK PARAMETERS
log(throughput) – δlog(delay) *higher value of delta prioritizes delay more*	• Link speed • Basic Topology • Traffic model • Buffer Size – *finite buffers to model loss*

REMY

CONGESTION SIGNALS
track state of the network

Add signal to account for loss

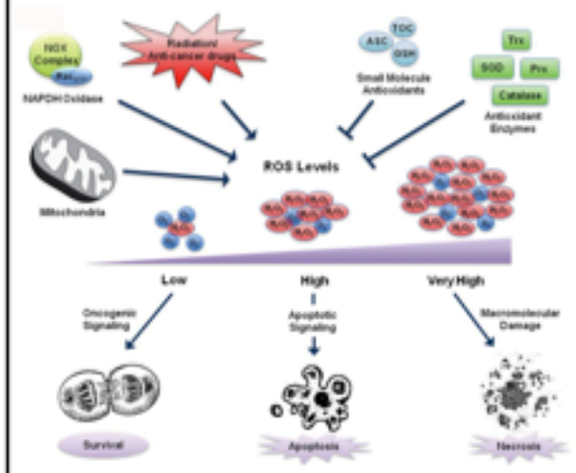
RemyCC (Mapping)

STATE → ACTION

example courtesy of Deepti Raghavan

Tell a story

Understanding Oxidative Stress



Reactive oxygen species (ROS) play a key role of regulating **homeostasis** and **apoptosis** in cells via signaling pathways

ROS (Reactive oxygen species)

Oxygen	Superoxide anion	Peroxide
O_2	$\cdot O_2^-$	$\cdot O_2^{-2}$
Hydrogen Peroxide	**Hydroxyl radical**	**Hydroxyl ion**
H_2O_2	$\cdot OH$	OH^-

Project Motivation

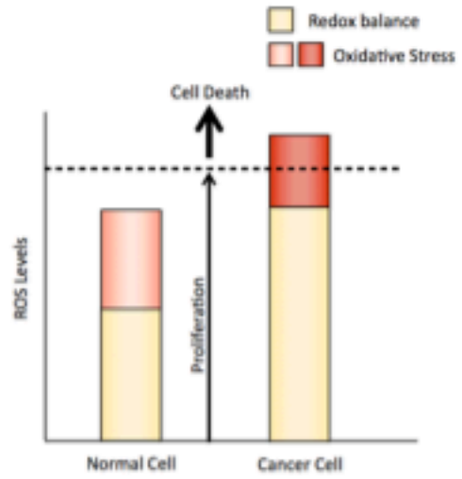
Cancer cells function at higher ROS levels

↓

Increasing ROS levels can selectively kill cancer cells

↓

Inhibiting peroxiredoxin, a H_2O_2 scavenger, can selectively kill cancer cells



Few known peroxiredoxin inhibitors

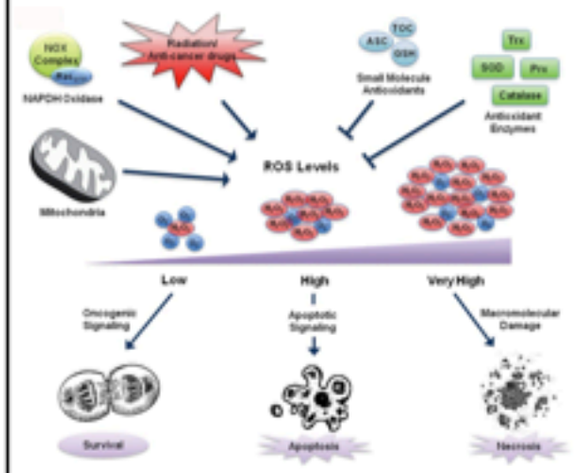
Does the presentation order on the poster make sense? Will the viewer want to look at or hear about the poster components in this sequence?

Common shortcoming:
crowding the poster with details, not putting up front what matters most, trying to display on the poster everything you know and have done

Solution: construct a story, start with what matters most

example courtesy of Kristen Eller

Understanding Oxidative Stress



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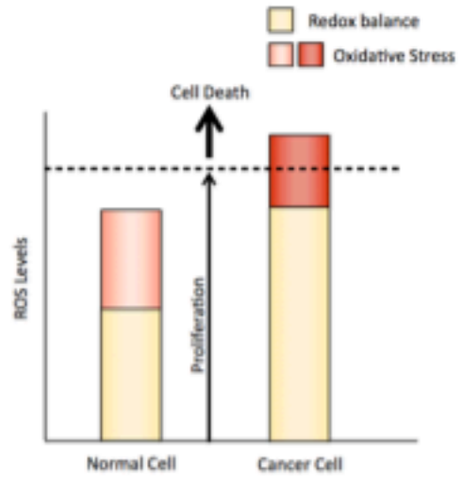

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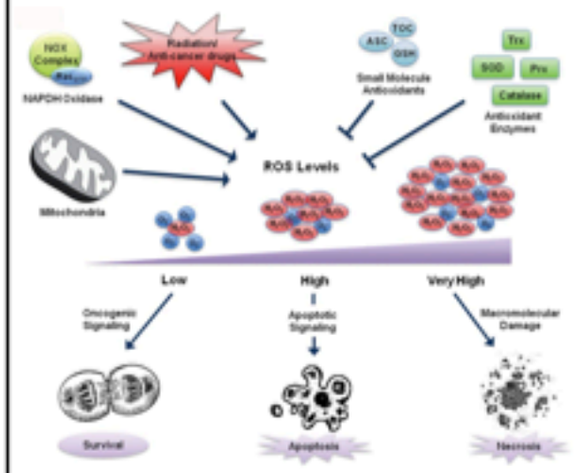

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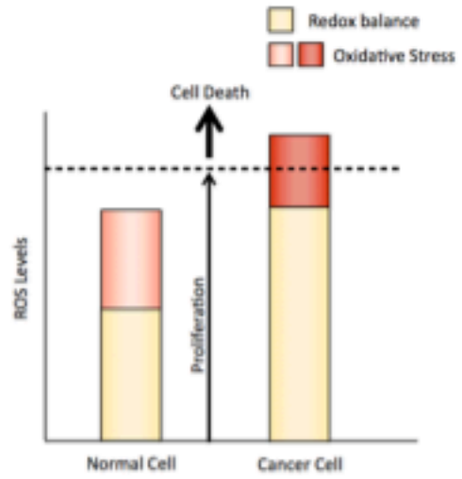


Few known peroxiredoxin inhibitors

BETTER:

Project Motivation

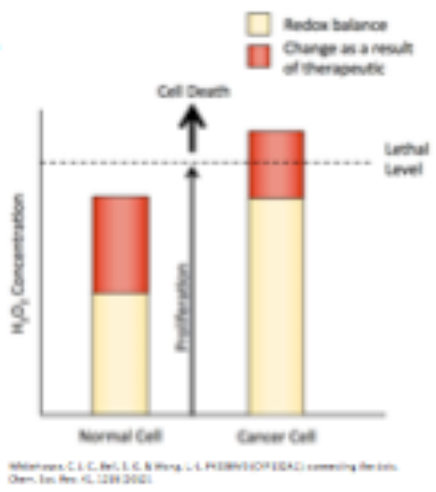
Cancer therapeutics work by exploiting differences between cancer and healthy cells

↓

Cancer cells function at higher concentrations of hydrogen peroxide

↓

Targeting redox biology of H_2O_2 defense in cancer cells could be used as a therapeutic approach

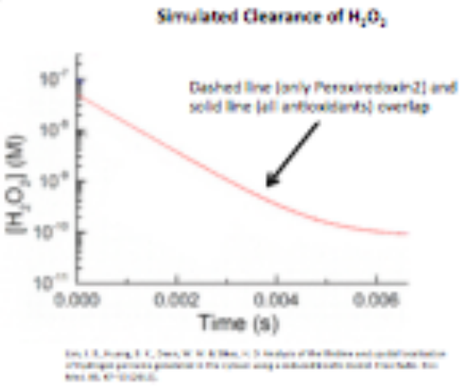


Problem Statement

How can we target H2O2 defense?

A large network of antioxidants are involved in scavenging H_2O_2

→ Kinetic modeling research has shown that **peroxiredoxin-2 is the primary scavenger of H_2O_2**



We need inhibitors of peroxiredoxin-2

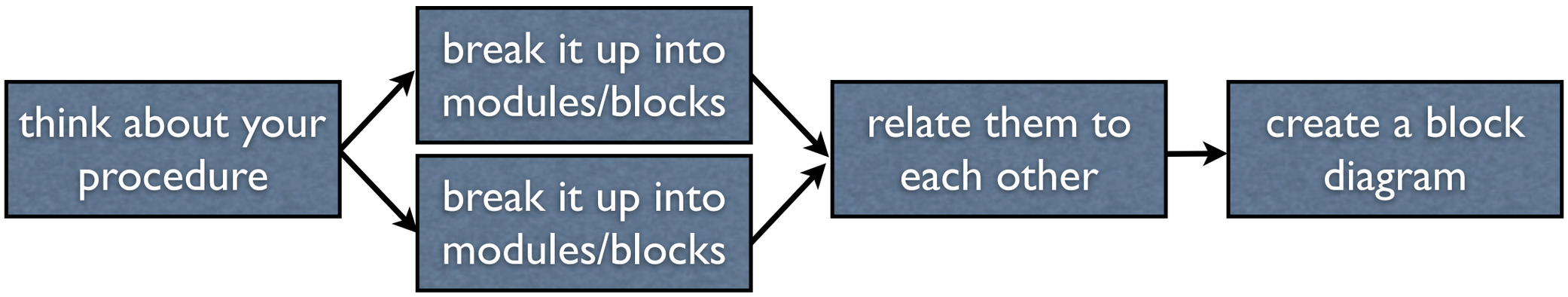
Goal: create a high throughput screen for inhibitors of peroxiredoxin-2

example courtesy of Kristen Eller

Add more figures

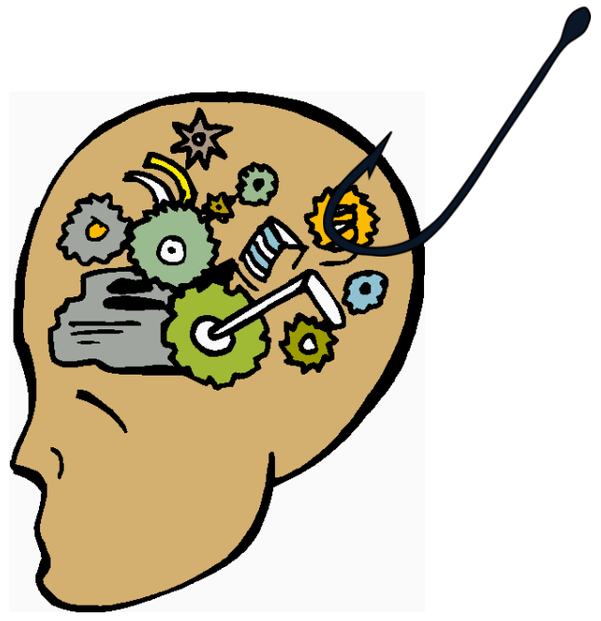
Which figures to include?

- Figures that help to convey and reinforce the message
- **Rule of thumb:** If you find yourself actively gesticulating to explain your project, turn each gesticulation into a figure
- Diagrams explaining your experimental set-up, equipment, tools, materials, etc.
- Diagrams from past/related work that help explain the background, set up the problem, etc.
- Block diagrams explaining your process/procedure, pipeline, algorithm, system components, etc.



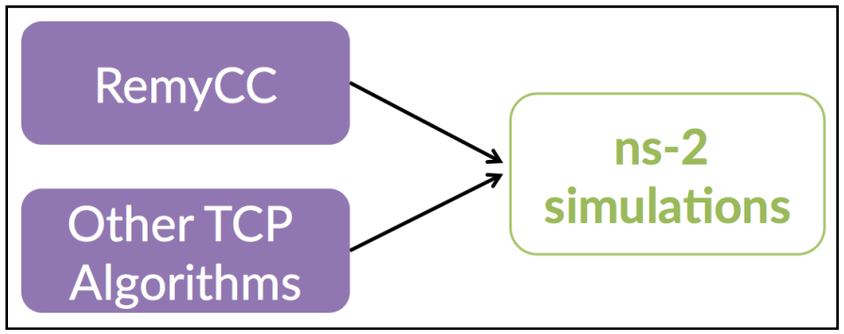
Don’t underestimate the power of pictures

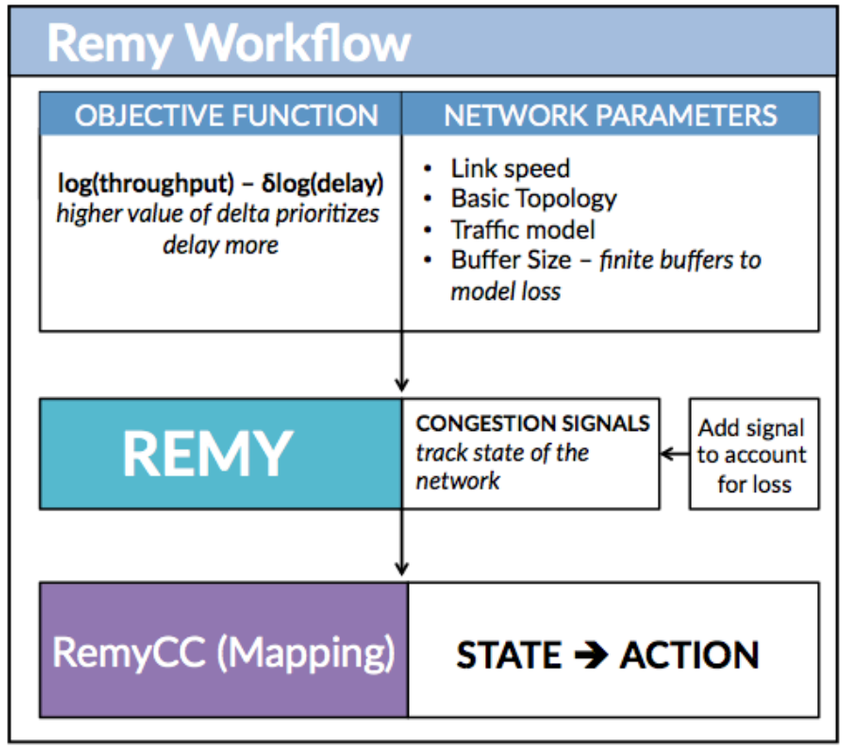
- Images can help **draw in** an audience
- Images can help people make **associations** with your content
- Images serve as a **hook into memory** to help people remember the content you described



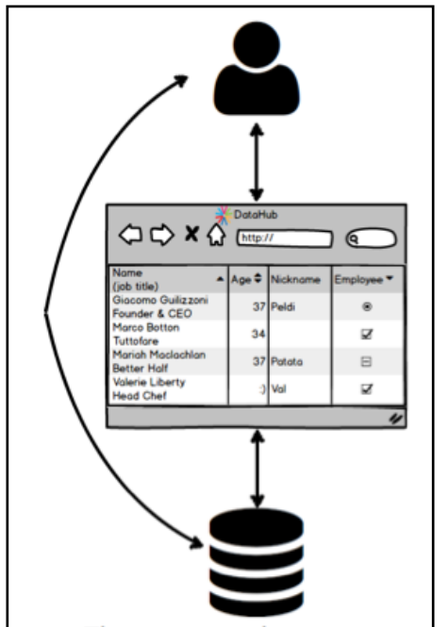
Borkin, Bylinskii, et al. “Beyond Memorability: Visualization Recognition and Recall” (2015)

What kind of figures can you make for a systems paper?



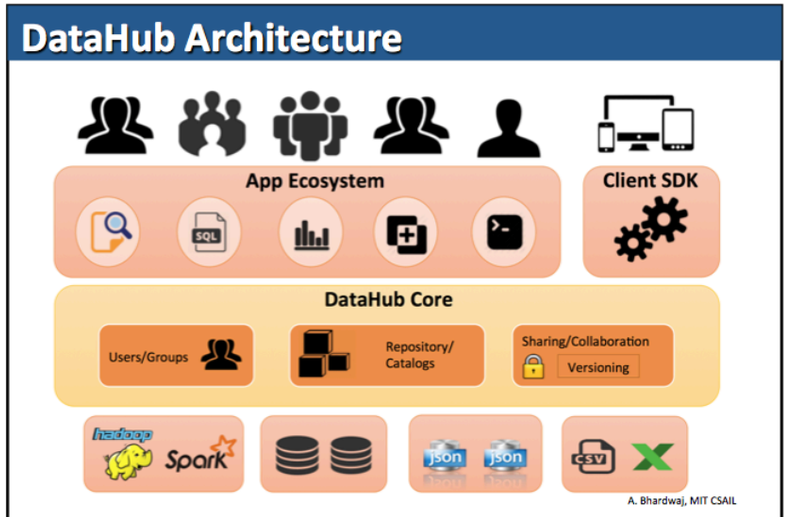


examples courtesy of Deepti Raghavan



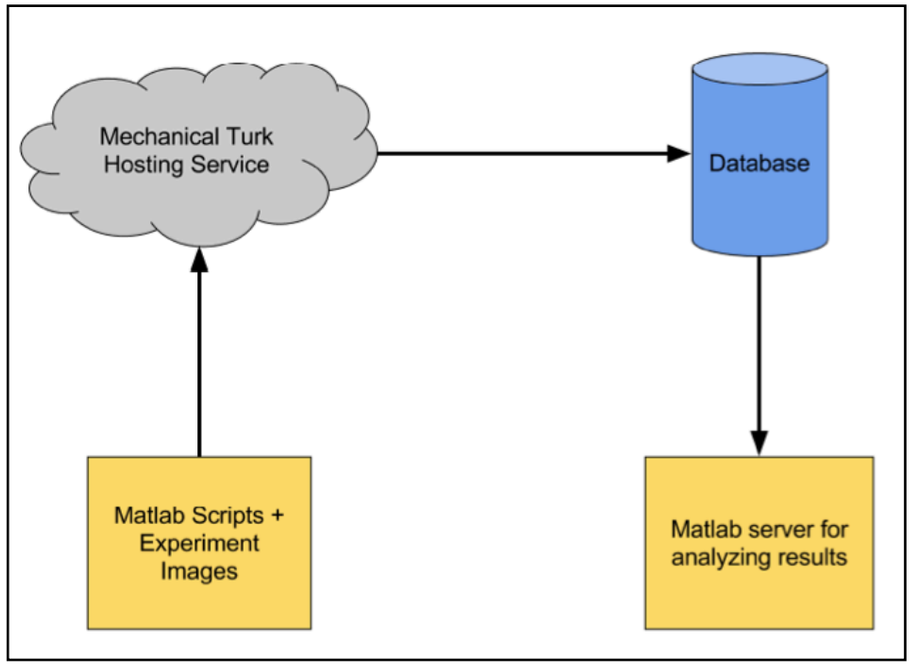
The user can choose to interact with the data directly or through the user-friendly DataHub interface.

examples courtesy of Kimberly Leon



DataHub was created to:

1. Allow non-technical users to understand and perform basic manipulations on data
2. Let technical users efficiently work on sophisticated tasks



How can you make a theory poster visual?

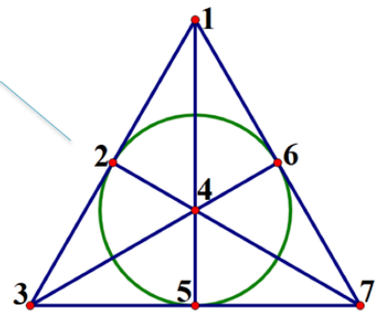
Project Background

The open problem of the existence of Finite Projective Planes of certain orders has interested mathematicians for decades.

Definition: A ***Finite Projective Plane (FPP) of order n*** is a collection of n^2+n+1 lines and n^2+n+1 points, such that:

- Every line contains n+1 points
- Every point is on n+1 lines
- Any two distinct lines intersect at exactly 1 point
- Any two distinct points lie together on exactly 1 line

"Lines": 6 line segments and 1 circle.
"Points": 7 intersections



L1={1,2,3}
L2={1,4,5}
L3={1,6,7}
L4={2,4,7}
L5={2,5,6}
L6={3,4,6}
L7={3,5,7}

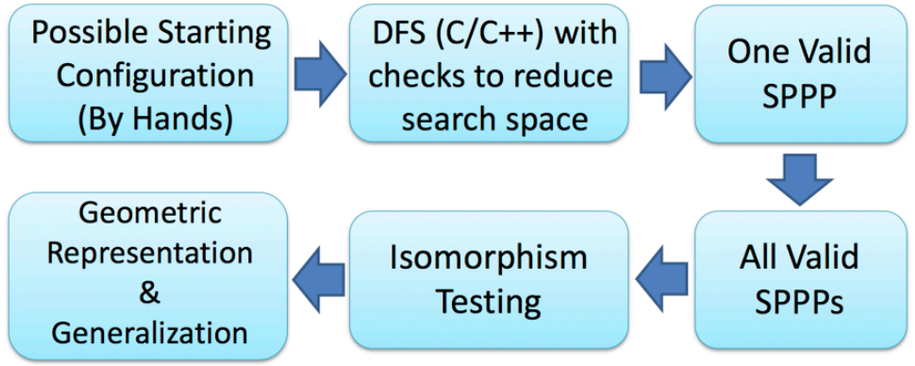
Finite Projective Plane of order 2

Technical Approach

The search space is **too large**!!

Need to do **Depth First Search (DFS)** combined with clever ways to use **symmetry**.

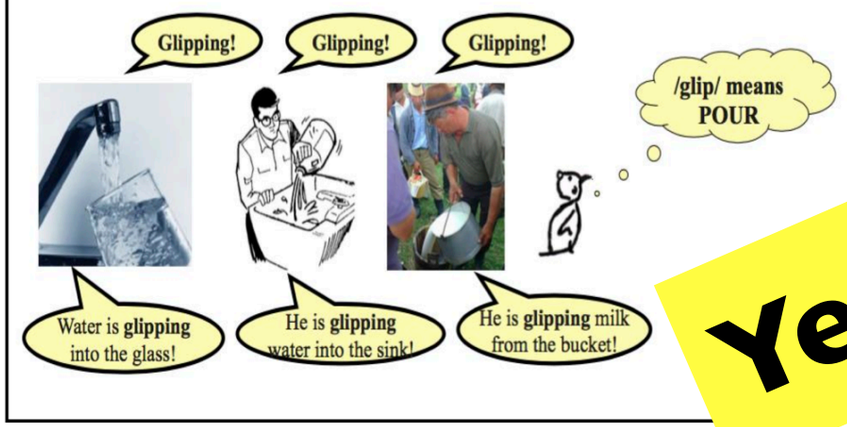
The number of possible lines is exponential in n, and the number of possible combinations of those lines is **exponential in exponential in n**. Ridiculously large!



But my topic matter is not visual...

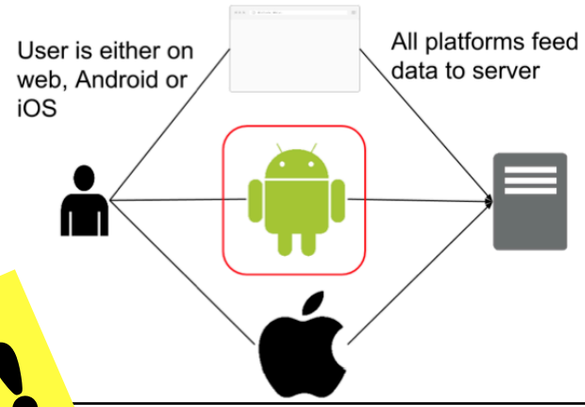
Research Question

How do children learn the syntax and semantics in their first language?



Objectives

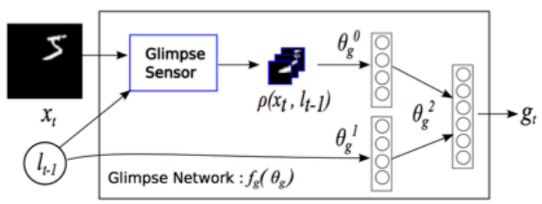
Develop an Android application to serve as a new experimental platform



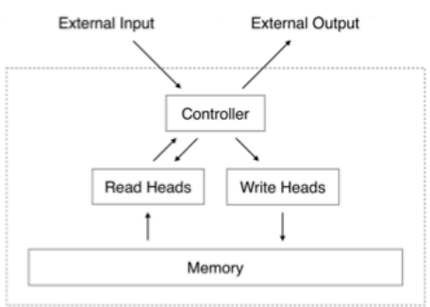
Yes, it is!

Previous Work

Recurrent Models For Visual Attention[5]



Neural Turing Machines[3]



gress: Setup & data exploration

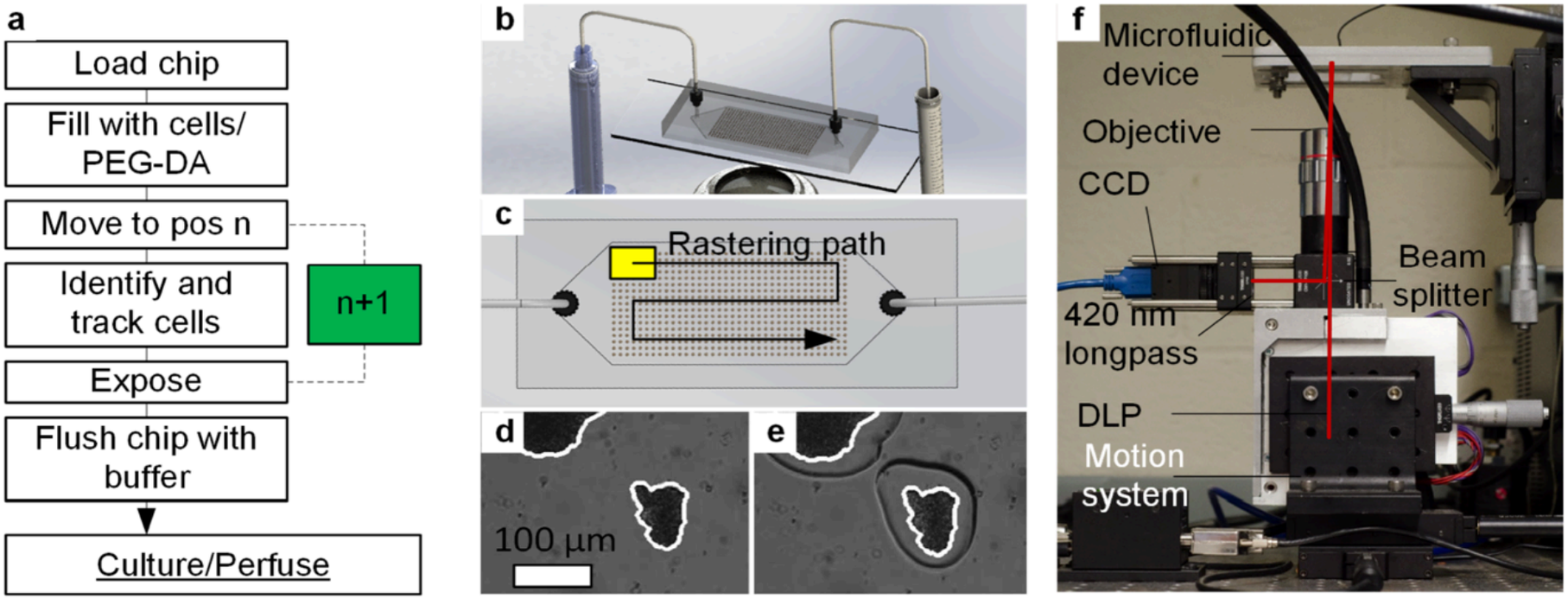
Background: Results of this project will be used for the back-end of an Android reading application.

1. **Integrated back-end with front-end** to enable A) recommendations and B) data collection

Python back-end — *Google App Engine* — *Android front-end*

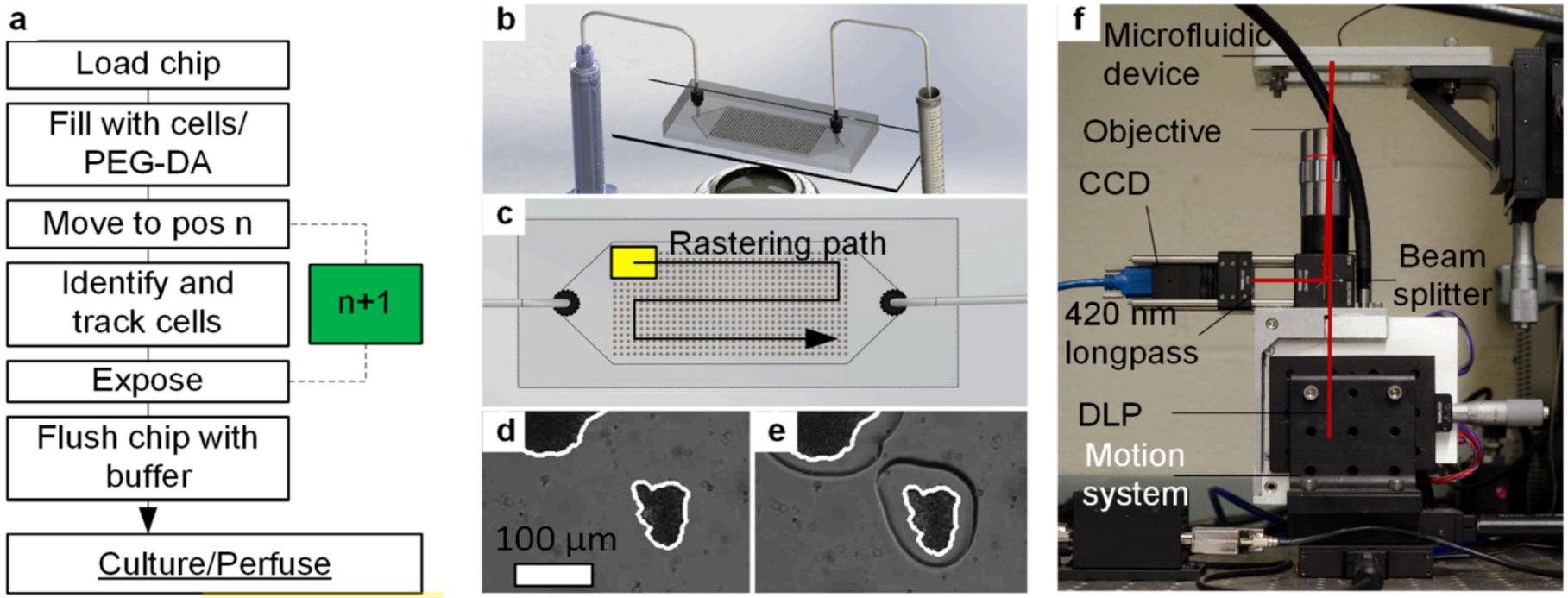
2. **Code development** for extraction of text features & understanding predictors of text difficulty

Labeling figures



a. Block diagram of the procedure used with our system
b. Prepared microfluidic channel
c. The rastering path the light and camera use to move over the chip
d. Distance-based image processing detecting a cell
e. The cell attached to the chip having been polymerized
f. Image of the 2D system with labeled components

Labeling figures



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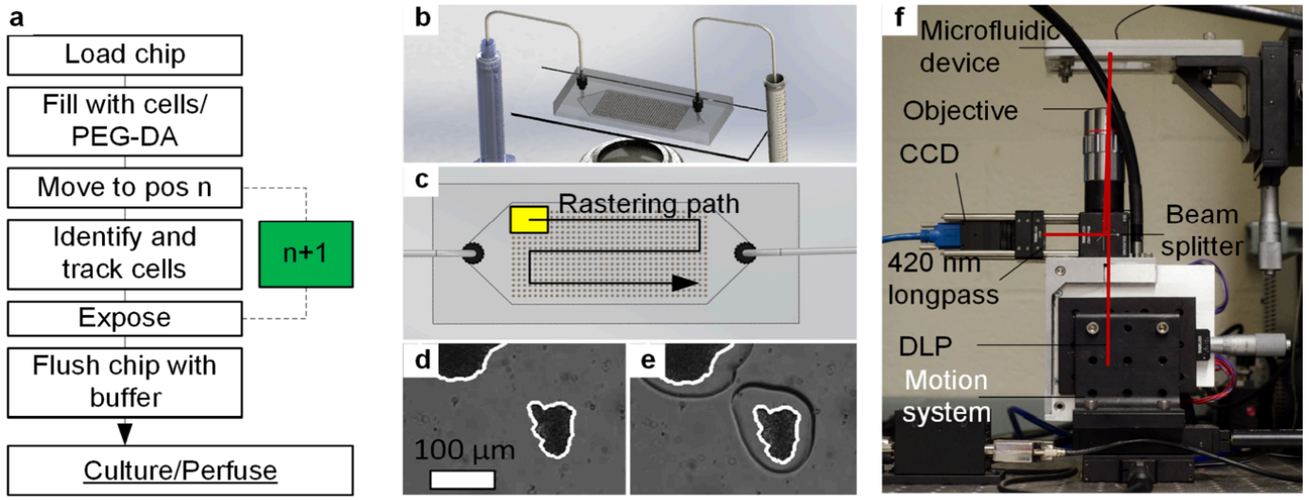
Yes, I can see that's an image...

Common shortcoming:
Crowding image captions with unnecessary, obvious, or redundant words.

Labeling figures



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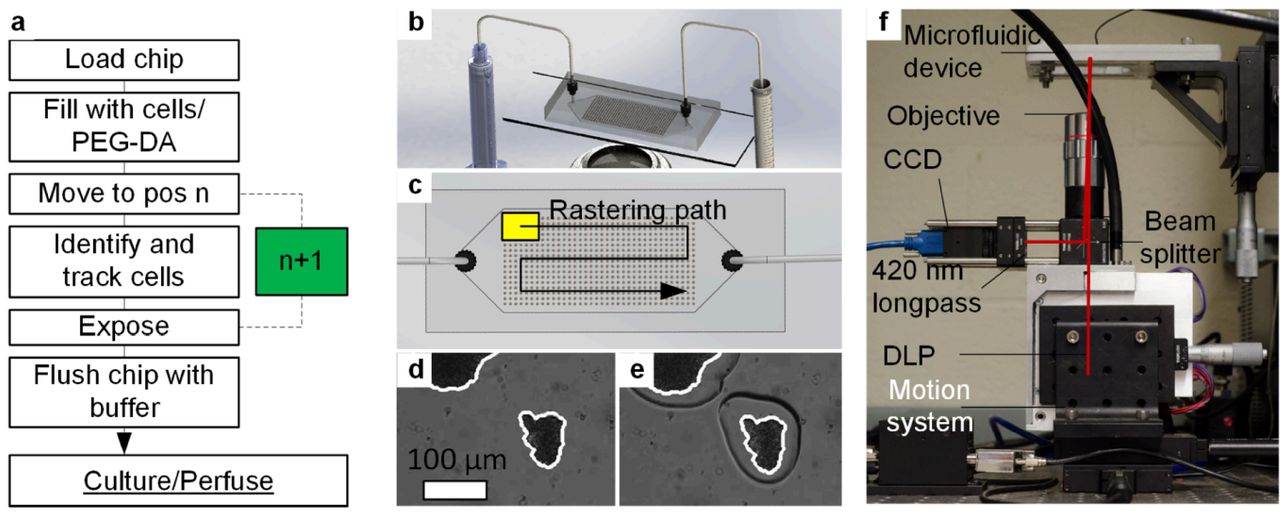


a. Procedure used by our system
b. Microfluidic channel
c. The light and camera's rastering path over chip
d. Distance-based image processing detecting cell
e. Cell in chip polymerized by stereolithography
f. 2D system with labeled components

Fix minor layout issues

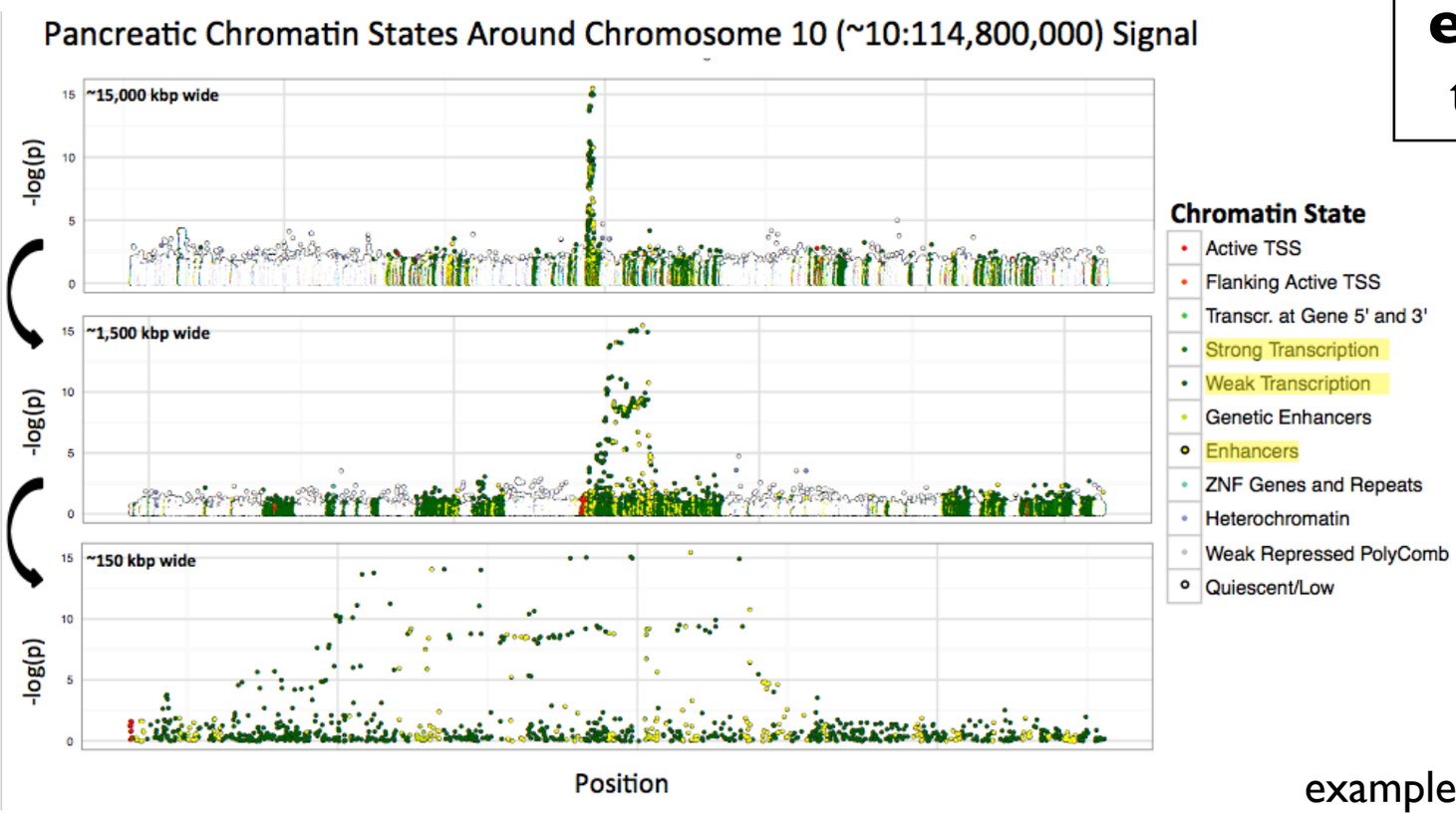
Minor things are minor, right?

- If something small jumps out at your viewer, it will distract them
- If a viewer can notice something that's off, chances are they will
- The human visual system is good at picking up on *inconsistencies*
- **Goal: maximize the signal to noise ratio**
- Check:
  - ❑ are you consistent with your font choices and sizes?
  - ❑ are you consistent with spacing your poster elements?
  - ❑ are all boxes on your poster aligned with each other?
  - ❑ does the poster guide the viewer's eyes in the right order?

Avoid tiny text at all costs

Titles and axis labels should be legible.
If you can not display all of your legend or all of your annotations, **leave only the crucial elements**, explain the rest in words.

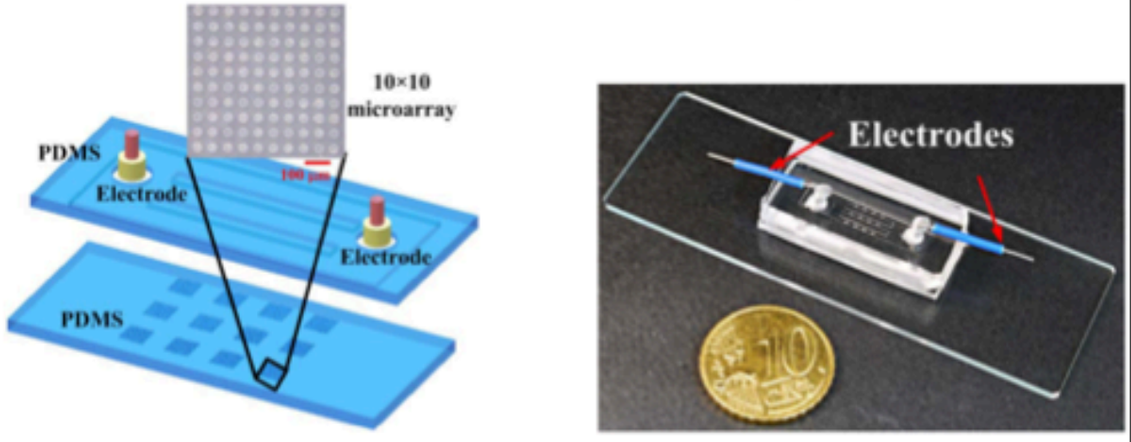
BETTER:



example courtesy of Daniel Sosa

Introduction

- Microfluidic diagnostics for pharmaceuticals do not precisely replicate the structure of living tissue
- Current available technologies are expensive, time consuming, and inefficient in creating devices



a. Traditional microfluidic structure that does not adequately replicate organ structure
b. Typical size and shape of a microfluidic channel

Making the viewer's eyes move all over the place requires more sustained attention. Try to reduce required eye movement by placing related elements together.

BETTER:

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- Microfluidic diagnostics for pharmaceuticals do not precisely replicate the structure of living tissue
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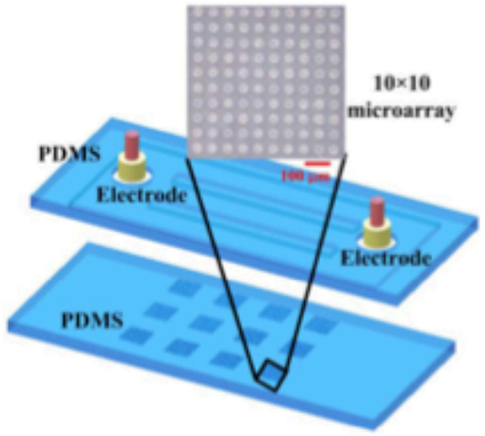
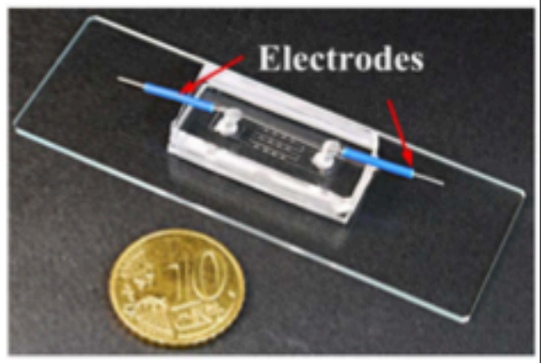


(a)



(b)

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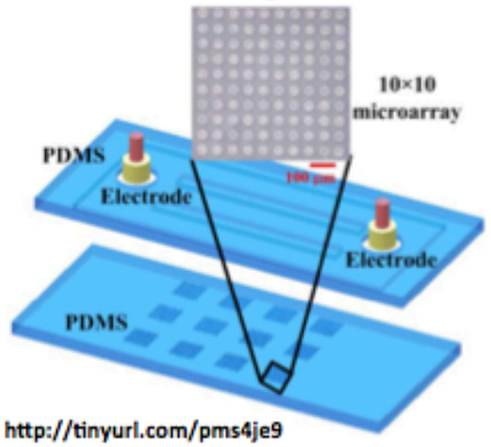
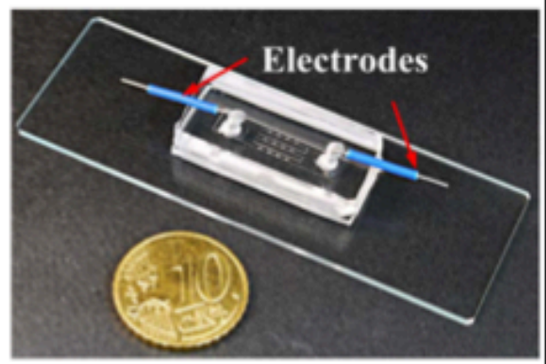
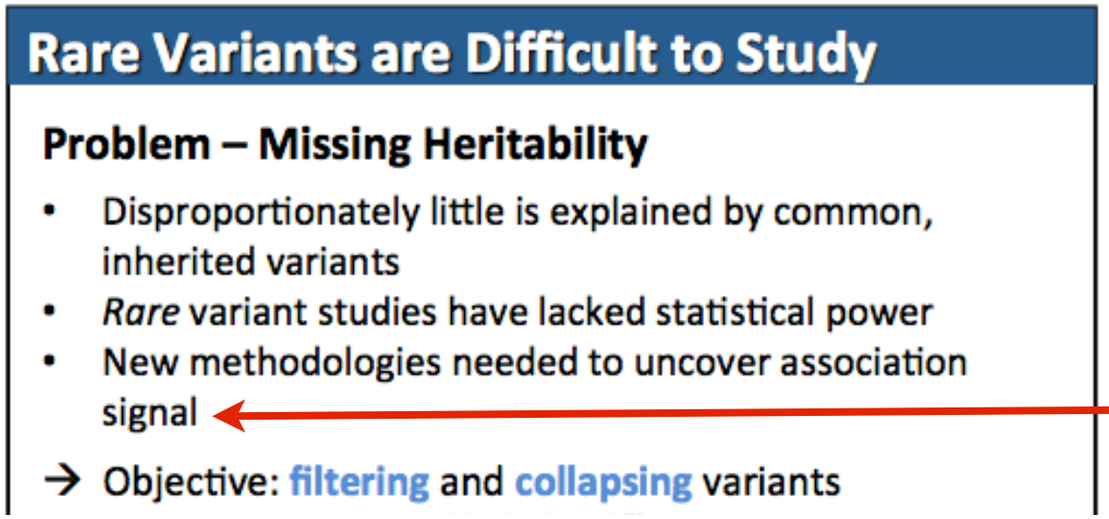


http://tinyurl.com/pms4je9

Traditional microfluidic structure that does not adequately replicate organ structure



Typical size and shape of a microfluidic channel



dangling words

waste space and energy:
- they add a whole extra line that could otherwise be used for other content
- they require the reader to move their eyes to the next line for only one word

example courtesy of Daniel Sosa

Rare Variants are Difficult to Study

Problem – Missing Heritability

- Disproportionately little is explained by common, inherited variants
- *Rare* variant studies have lacked statistical power
- New methodologies needed to uncover association signal

→ Objective: filtering and collapsing variants

BETTER:

Rare Variants are Difficult to Study

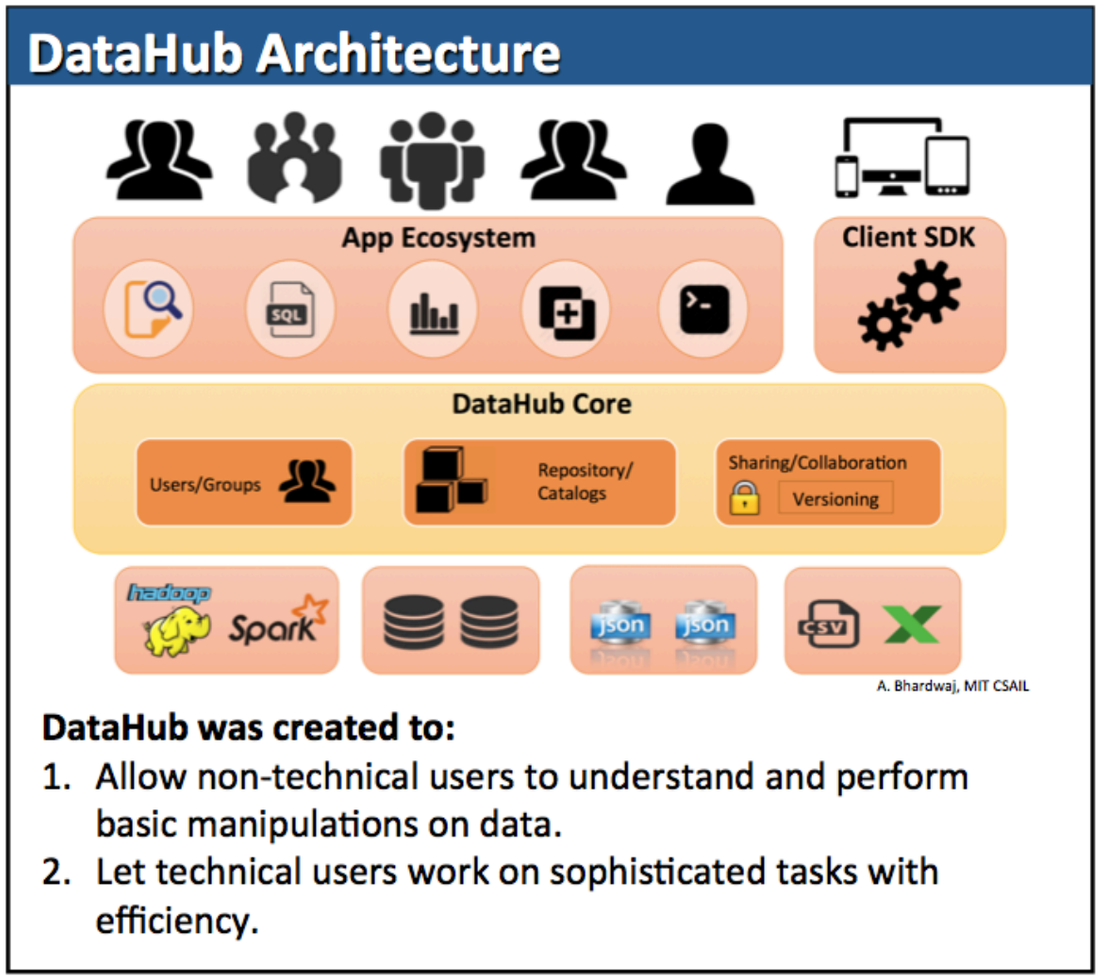
Problem – Missing Heritability

- Disproportionately little is explained by common, inherited variants
- *Rare* variant studies have lacked statistical power
- New methods needed to uncover association signal

→ Objective: filtering and collapsing variants

A slight **rewording** is often the best solution, though **text box resizing**, or **font resizing** can be used as well (provided the formatting stays consistent with the rest of the poster)

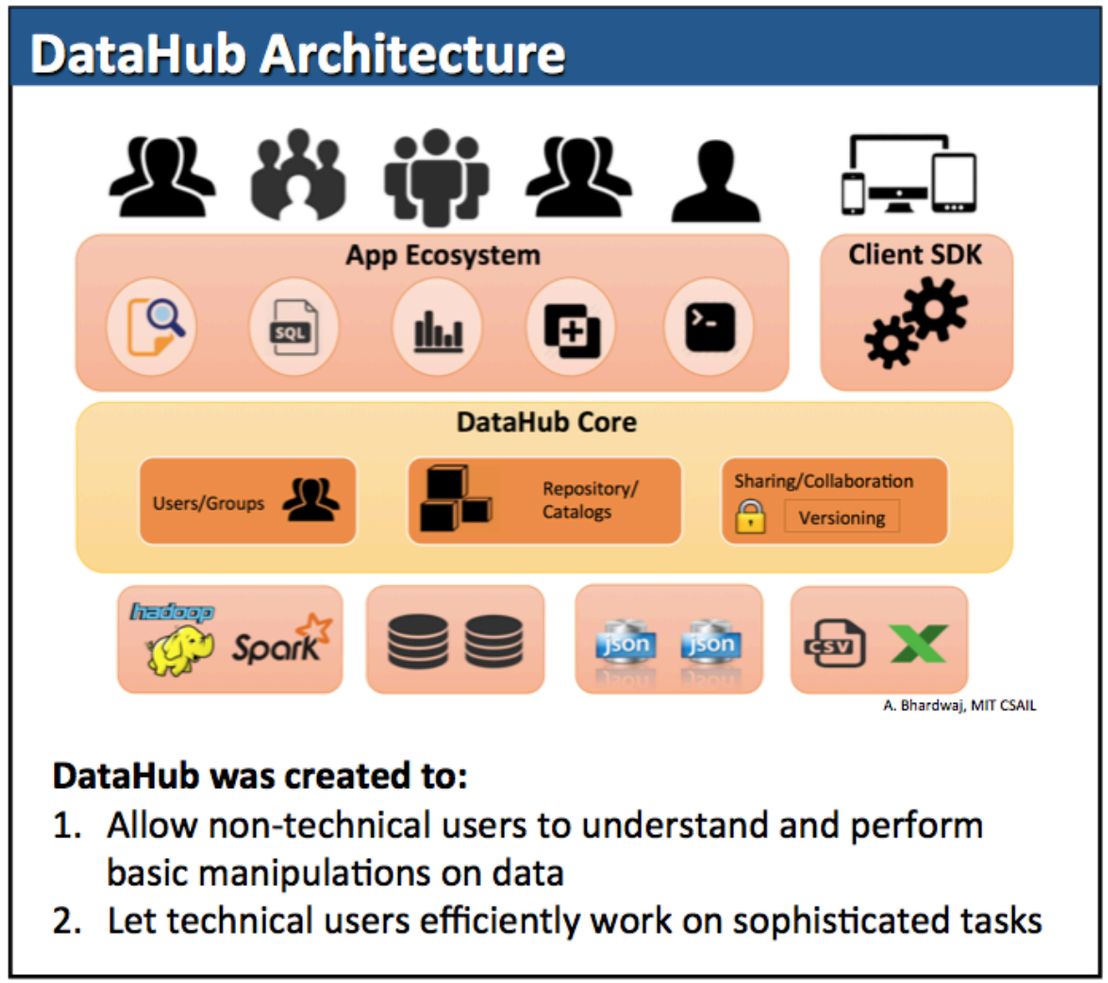
example courtesy of Daniel Sosa



DataHub was created to:

1. Allow non-technical users to understand and perform basic manipulations on data.
2. Let technical users work on sophisticated tasks with efficiency.

BETTER:



DataHub was created to:

1. Allow non-technical users to understand and perform basic manipulations on data
2. Let technical users efficiently work on sophisticated tasks

example courtesy of Kimberly Leon

Minor layout changes can improve parsing ability

myMemory: Understanding Human Memory

Massachusetts Institute of Technology
School of Engineering
SuperUROP
2015–2016

BETTER:

MyMemory:
Understanding Human Memory

Massachusetts Institute of Technology
School of Engineering
SuperUROP
2015–2016

Application of principles

Syntactical and Semantic Language Acquisition

Massachusetts Institute of Technology
School of Engineering
SuperUROP 2015–2016

Dillon Dumesnil, Supervised by: Robert Berwick (Electrical Engineering and Computer Science)
Mason Undergraduate Research and Innovation Scholar

Research Question

How do children come to acquire their knowledge of both syntax and the semantics of the particular language in which they grow up, given limited experience?

Goal

Detect with a high level of certainty what an unknown verb means both syntactically and semantically

Evidence X	$p(H_1\|X)$	$p(H_*\|X)$	$p(H_0\|X)$
F0	.033	.333	.633
F0, F0	.002	.216	.781
F0, F1	.137	.724	.137
F0, F1, F1, F1, F1, F1	.712	.288	5e-6
F0, F0, F0, F0, F0, F0	2e-8	.021	.979
F0, F1, F0, F1, F0, F1	.007	.986	.007

F0 – evidence for internally caused.
F1 – evidence for externally caused.
H0 – hypothesis confirming F0.
H1 – hypothesis confirming F1.
H* – hypothesis confirming externally causable (mix of F0 and F1). [1]

Procedure / Equipment

1. Search for common childhood verbs in the database.
2. Parse through the results to discover different information such as which child used the verb, how it was used, and their age when they used the verb.
3. Use Bayesian inference to determine which hypothesis best fits the verb.
4. Expand the number of hypotheses and verbs the software is able to handle while maintaining high levels of correctness

This is the database containing different sentences to analyze.

These are some of the different filters that can be applied to help search through the database with greater efficiency. [2]

Further Research

- Expand number of verbs to analyze by going through different classes of verbs as expressed by Beth Levin [3].
- Handle more real-life situations
  - Older siblings
  - Bilingual parents
- Increase number of hypotheses to consider per verb

References

[1] Niyogi, Sourabh. "Bayesian learning at the syntax-semantics interface." *Proceedings of the 24th annual conference of the Cognitive Science Society.* Vol. 36. 2002.

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example courtesy of Dillon Dumesnil

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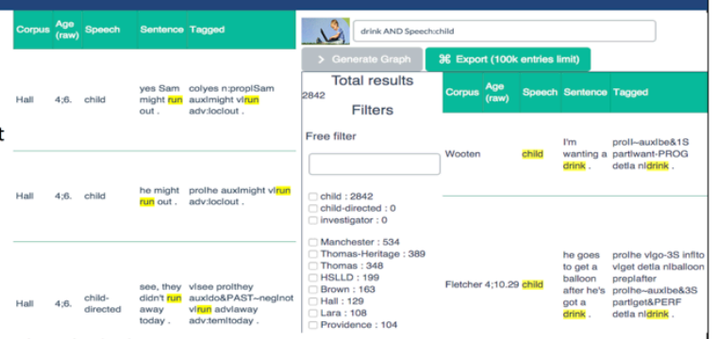

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[3] Levin, Beth. *English Verb Classes and their Alternations*. Chicago, Univ. Chicago Press, 1983.

Problem:
high density of content, especially text, throughout - and even the figures/tables in the second box seem crowded.

Solution:
start cutting and condensing text, using gained space to expand the figures.

example courtesy of Dillon Dumesnil

BETTER:

Research Question

How do children come to acquire their knowledge of both syntax and the semantics of the particular language in which they grow up, given limited experience?

Research Question

How do children learn the syntax and semantics in their first language?

Visible at first-glance, straight and to the point!

example courtesy of Dillon Dumesnil

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Instead of copy-pasting a figure or table from a paper, and having a low-resolution table with different formatting than the rest of the poster...

Recreate the figure/table so it is in the **same style** as the rest of the poster. **Highlight key trends** to make them easier to explain during the poster presentation.

example courtesy of Dillon Dumesnil

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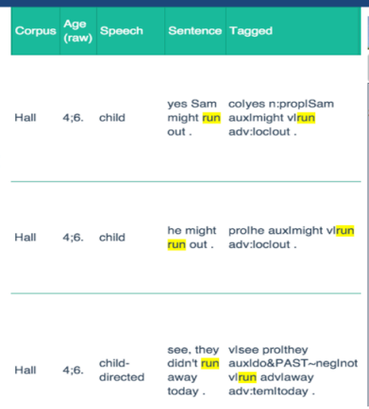

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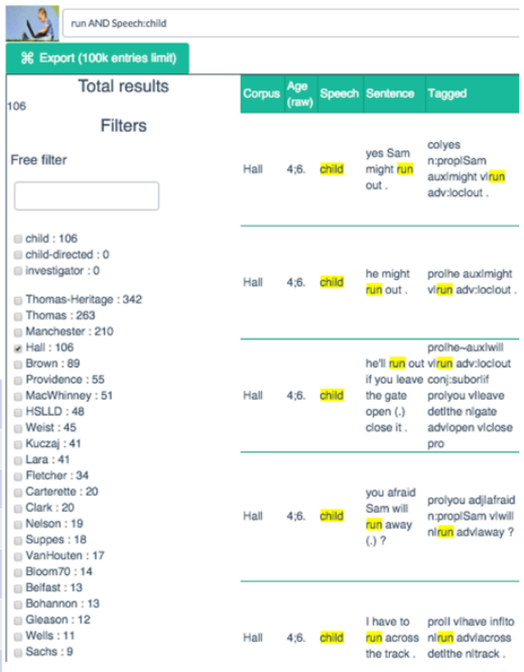

[1], [2]

BETTER:

Cutting down on text, and **prioritizing figures**
leaves more space for what's most important,
while leaving the details for the presentation.

example courtesy of Dillon Dumesnil

BETTER:

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Massachusetts Institute of Technology School of Engineering
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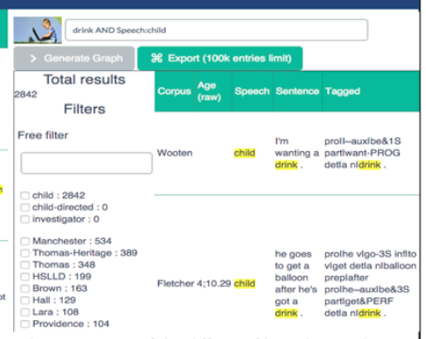

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How do children learn the syntax and semantics in their first language?

Goal

By looking at a feature of a verb, accurately determine the best fitting hypothesis

Cause Feature	Example sentences
1	Externally caused – Ex: touch, load
	F1: He touched the glass. F0: *The glass touched.
*	Externally causable – Ex: break, fill
	F1: He broke the glass. F0: The glass broke.
0	Internally caused – Ex: laugh, glow
	F1: *He laughed the children. F0: The children laughed

[1]

Procedure / Equipment

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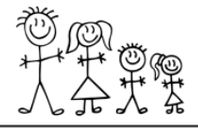
F0, F0, F0, F0, F0, F0	2e-8	.021	.979
F0, F1, F0, F1, F0, F1	.007	.986	.007

[1], [2]

Further Research

- Expand number of verbs using different verb classes [3].
- Increase number of hypotheses to consider per verb
- More complicated learning environments
  - Older siblings
  - Bilingual parents



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example courtesy of Dillon Dumesnil

Other resources:

- Poster examples with discussion of strengths and weaknesses: https://www.utexas.edu/ugs/our/poster/samples

- General communication guidelines: "Trees, maps, and theorems" by Jean-luc Doumont

- Designing effective graphs: "The Visual Display of Quantitative Information" and other books by Edward Tufte