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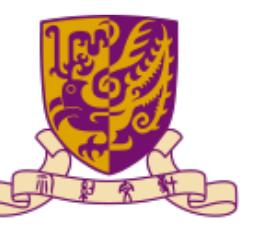
# **CSC4130**

# **Introduction to Human-Computer Interaction**

## **Lecture 2**

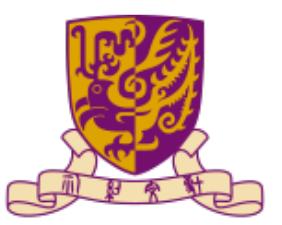
## **Human: Attention**





# Outline

- Control
- Information overload
- Simplicity
- Attention flows
- Design notes for attention



# Outline

- Control
- Information overload
- Simplicity
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- Design notes for attention

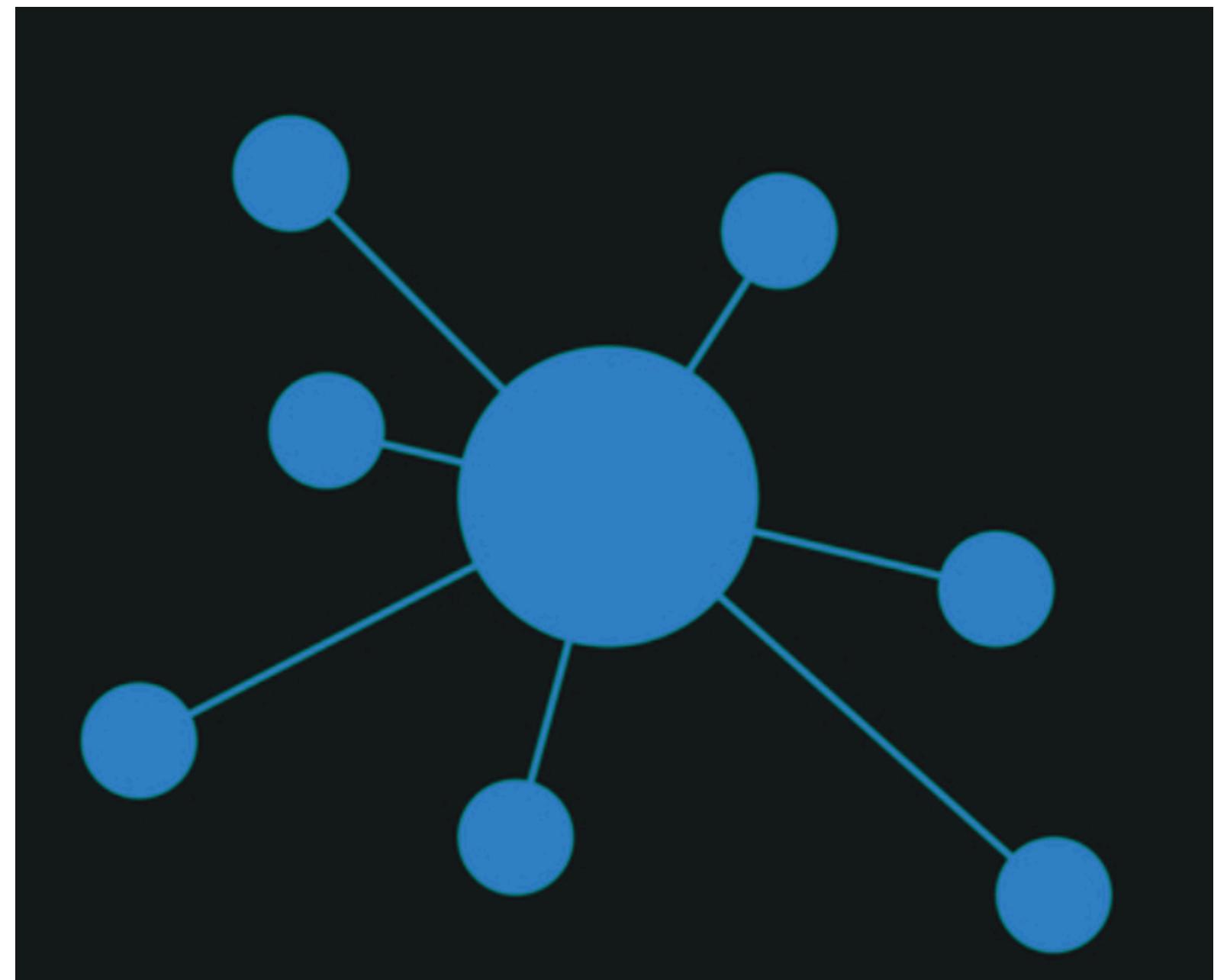
# Attention

- The action of dealing with or taking special care of someone or something



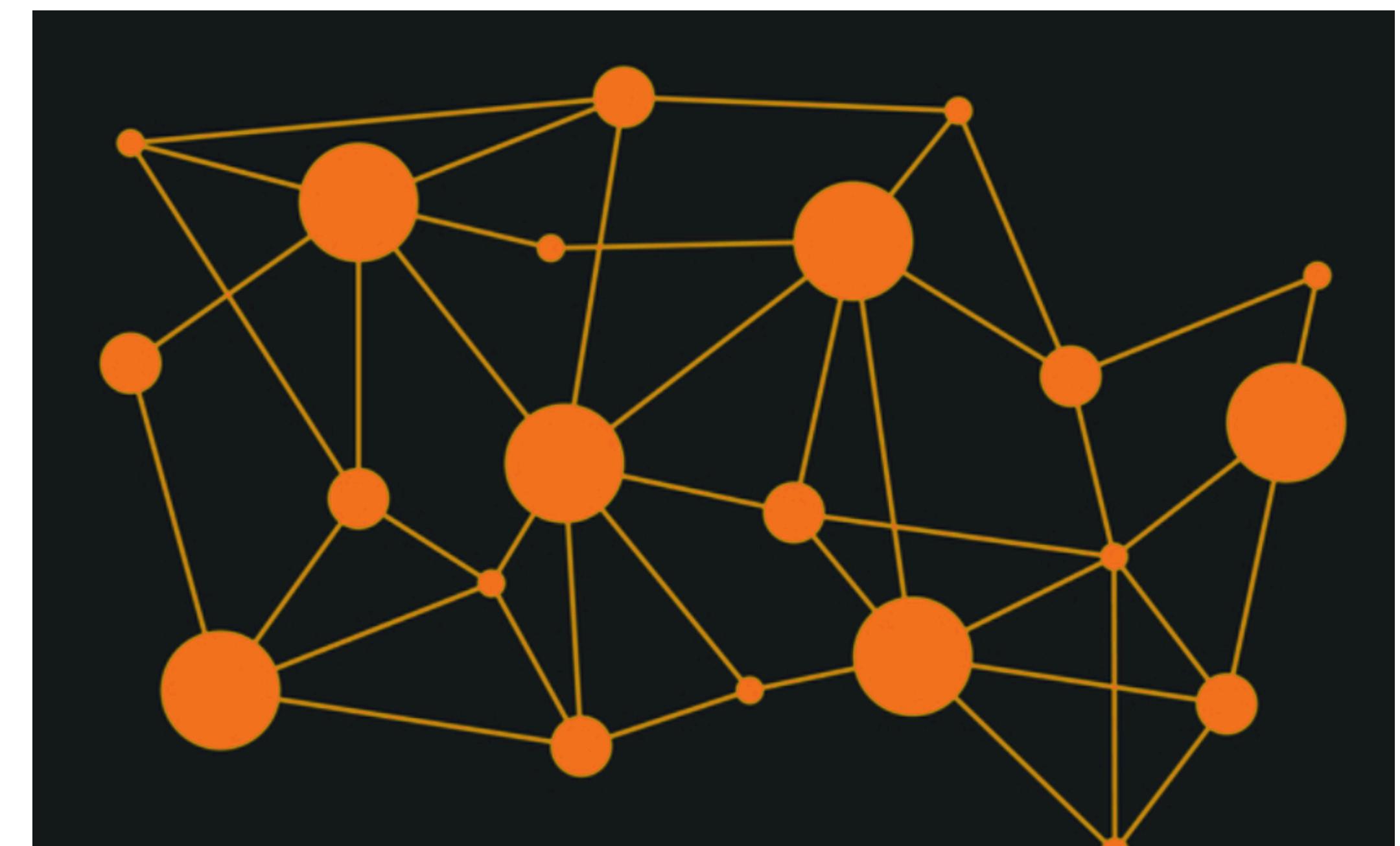
# Control

- Centralize (Von Neuman)
  - Central Processing Unit (CPU)
    - ◆ Control - can save a data state, handle an interrupt, then reload
    - ◆ Fragile - if the center fails, it all fails, so one bit can crash a computer



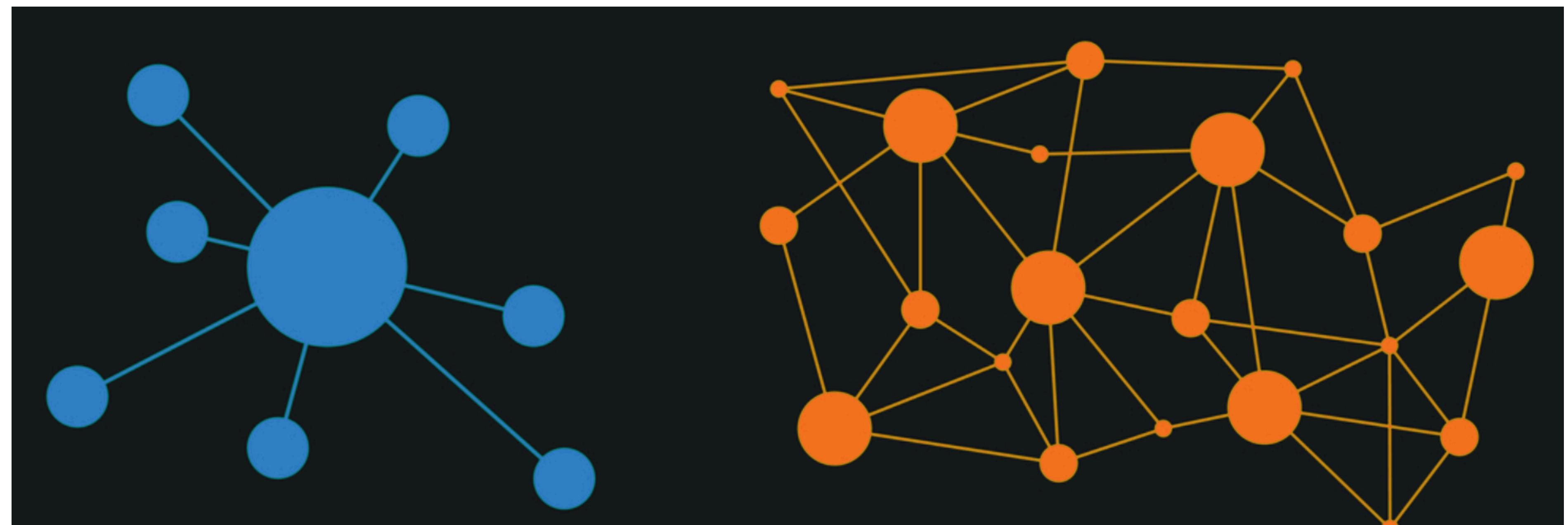
# Control

- Decentralize (Nature)
  - The brain
    - ◆ Reliable - a brain democracy is more stable than a computer dictatorship
    - ◆ Chaotic - cannot save the neuron interaction state and can hang, e.g., neurotic rocking



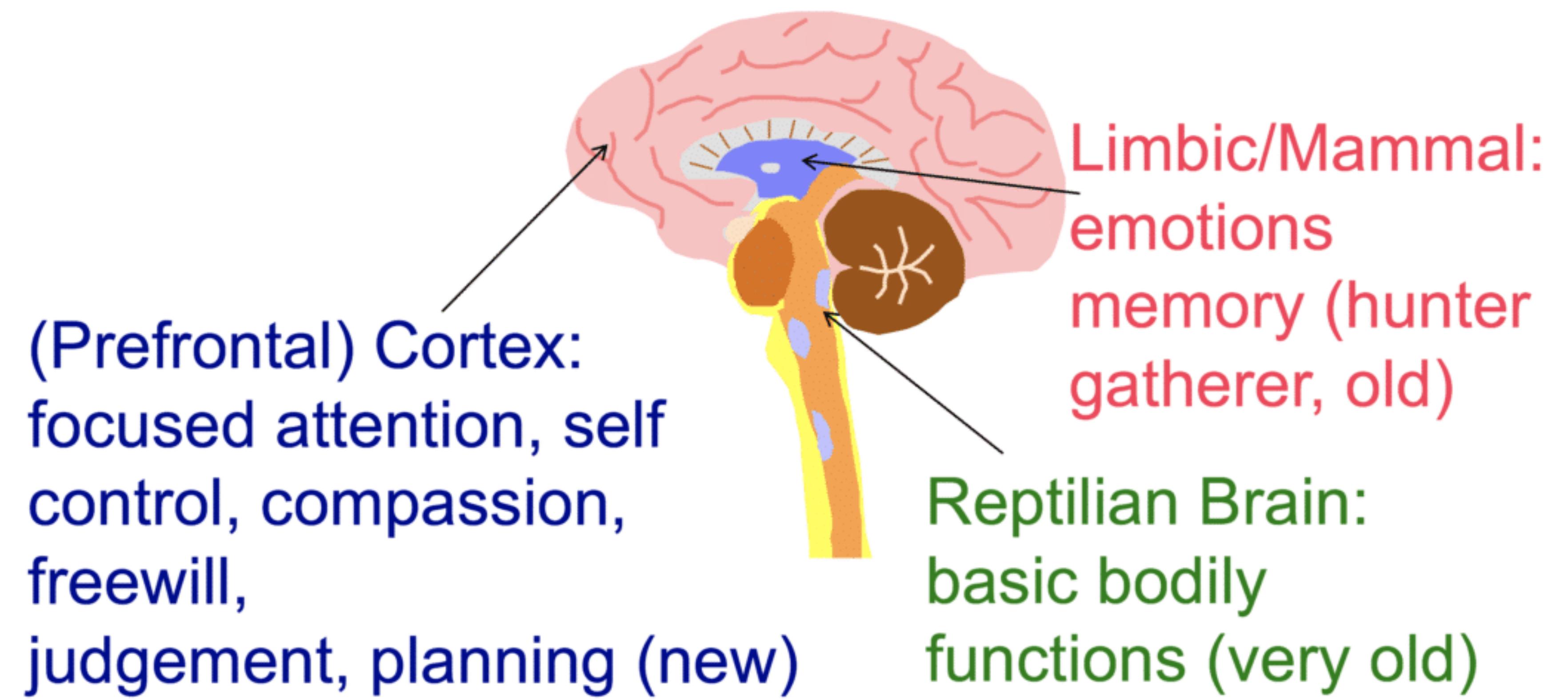
# Control

- Can be either
  - Networks
    - ◆ Centralized - polling is reliable but slow
    - ◆ Decentralized - carrier-sense multiple access with collision detection is 5-10 times faster but can hang



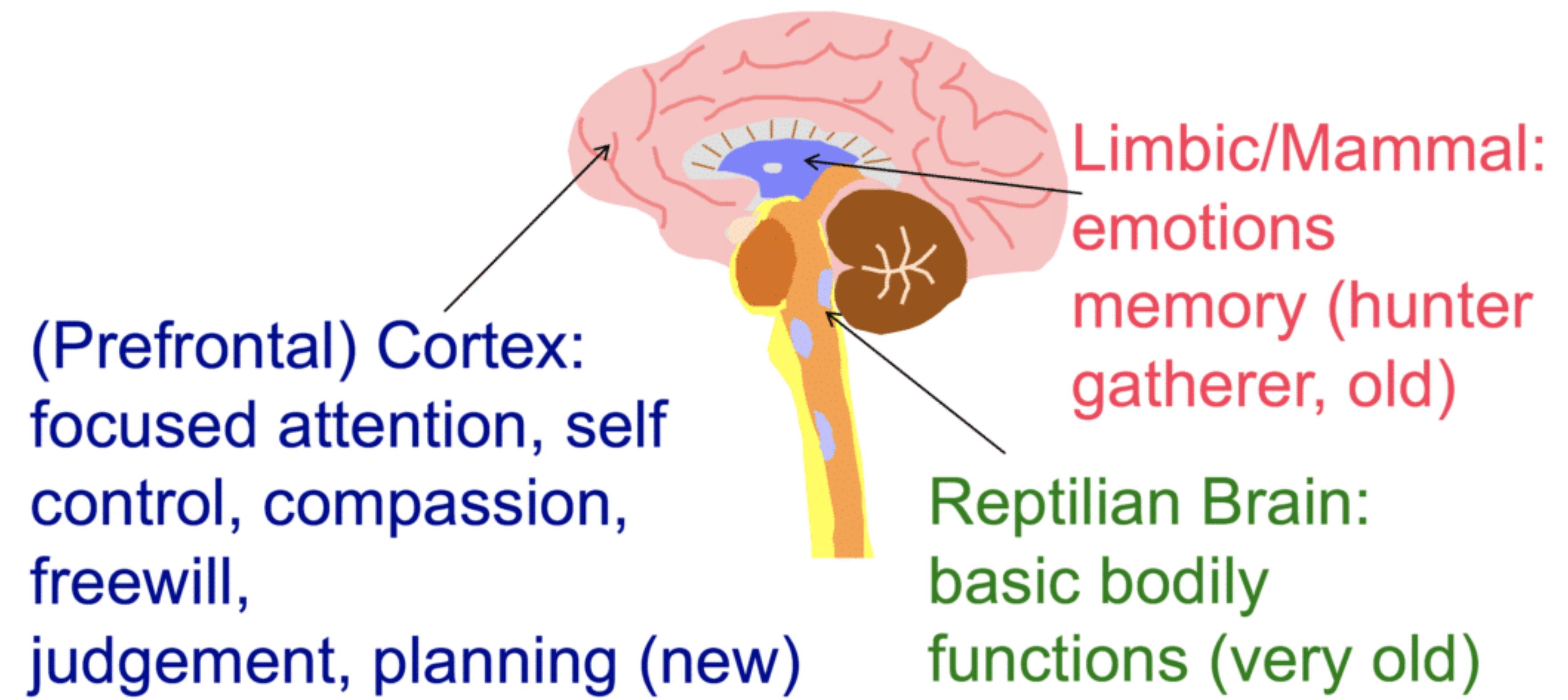
# Understanding of the brain

- The old brain
  - Movement
  - Digestion
  - Breathing



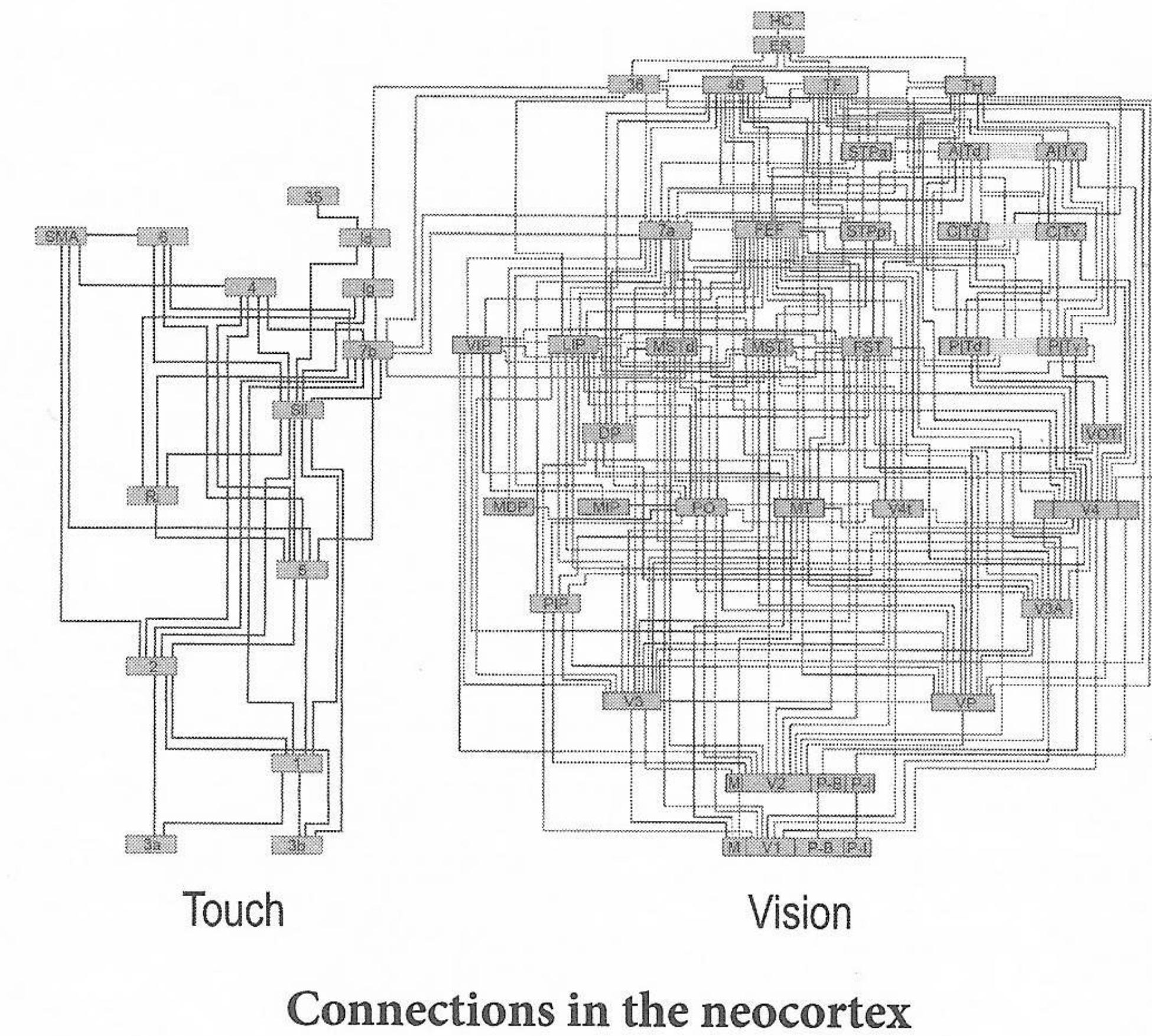
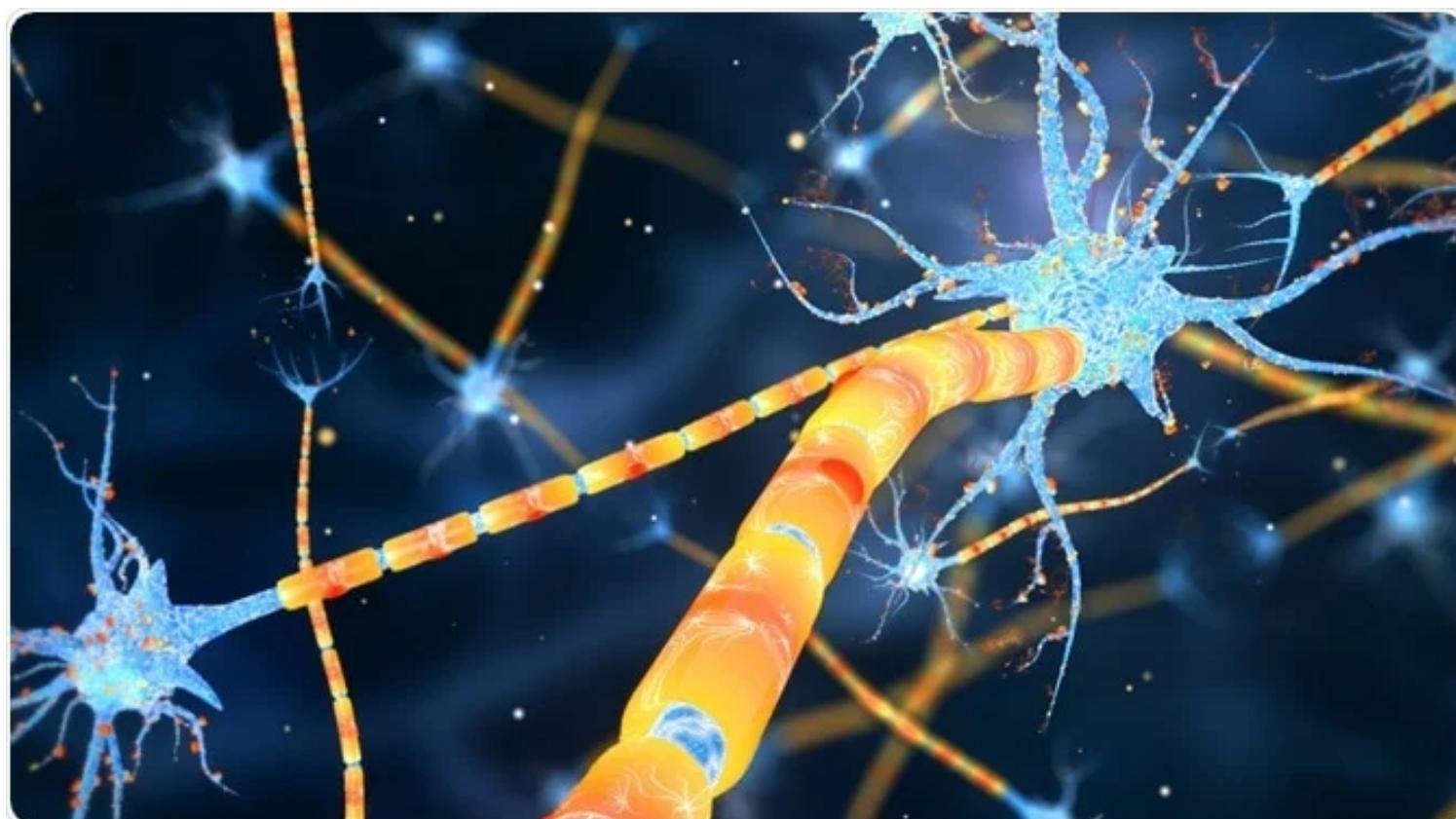
# Understanding of the brain

- The new brain
  - Neocortex
  - Language
  - Concept
  - Mathematics



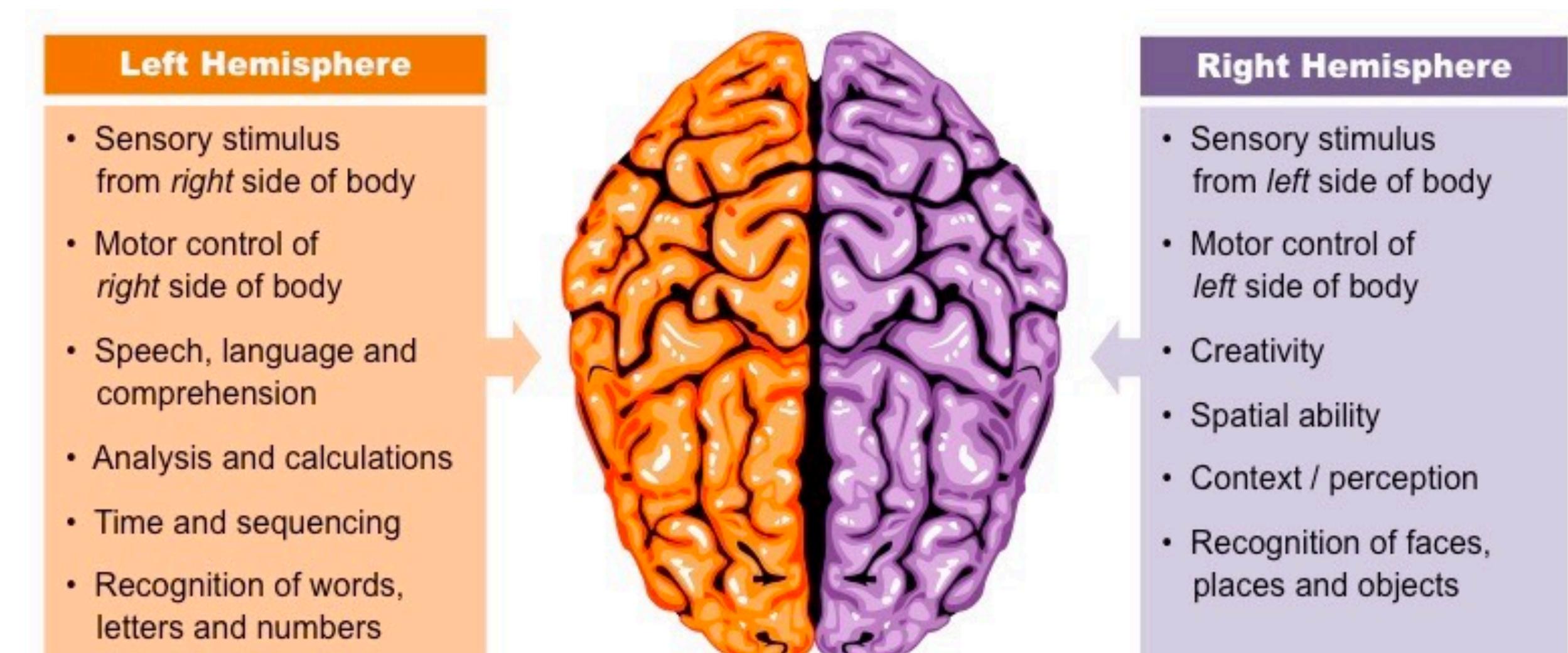
# Understanding of the brain

- Nerve fibers connect the old and new brains
- They work together to get something
- Old brain contains dozens of separate organs, which are visually distinct
- Neocortex in new brain are no visually distinct



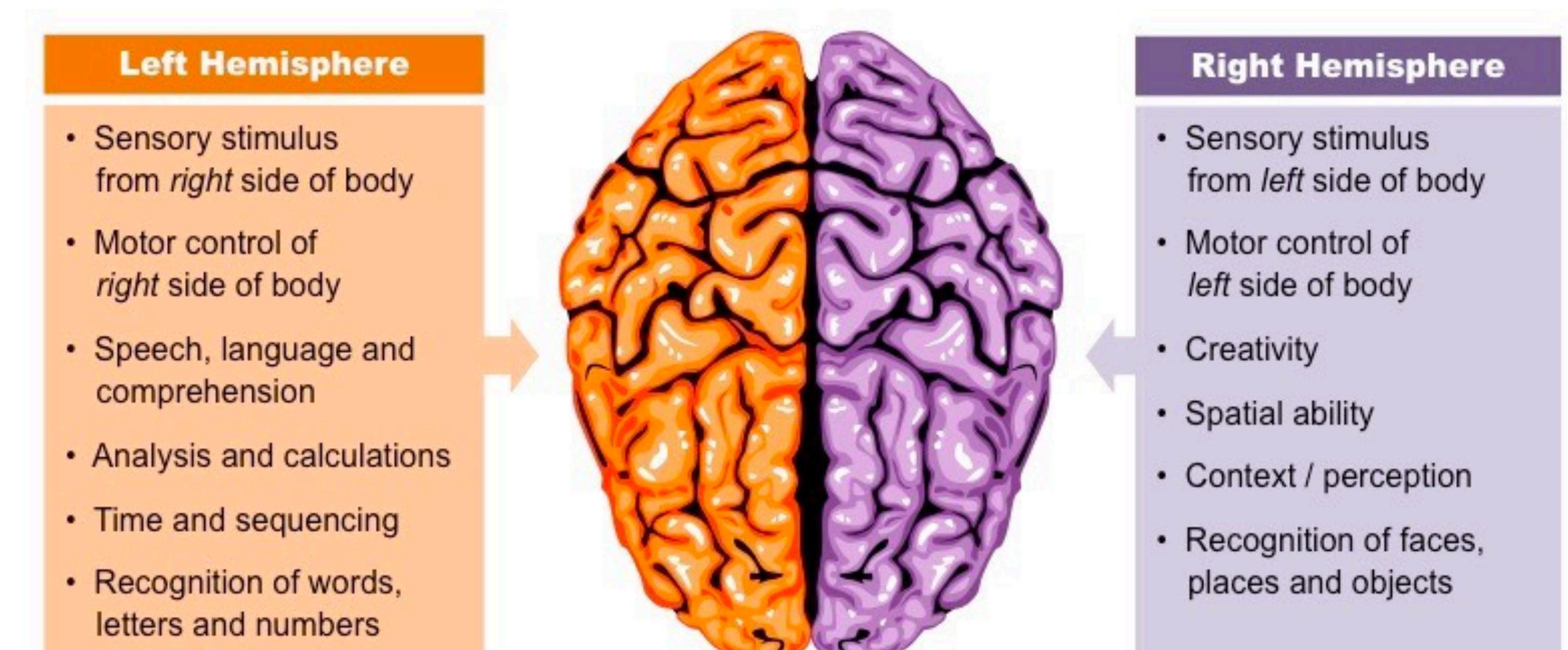
# Understanding of the brain

- The brain is split
  - Left hemisphere controls the right side
  - Right hemisphere controls left side
  - People with a stroke in one hemisphere lose function on the opposite side



# Understanding of the brain

- Specialization
  - Left hemisphere specializes in language
  - Right hemisphere specializes in space
  - They share the work
  - Each is also a backup



# Understanding of the brain

- Space function
  - Grid cell for navigating
  - Place cell for marking and recalling
  - Direction cell for directing a head is facing
- Language
  - Wernicker's area for language comprehension
  - Broca's area for language production

Why language cells only occur in the left hemisphere?

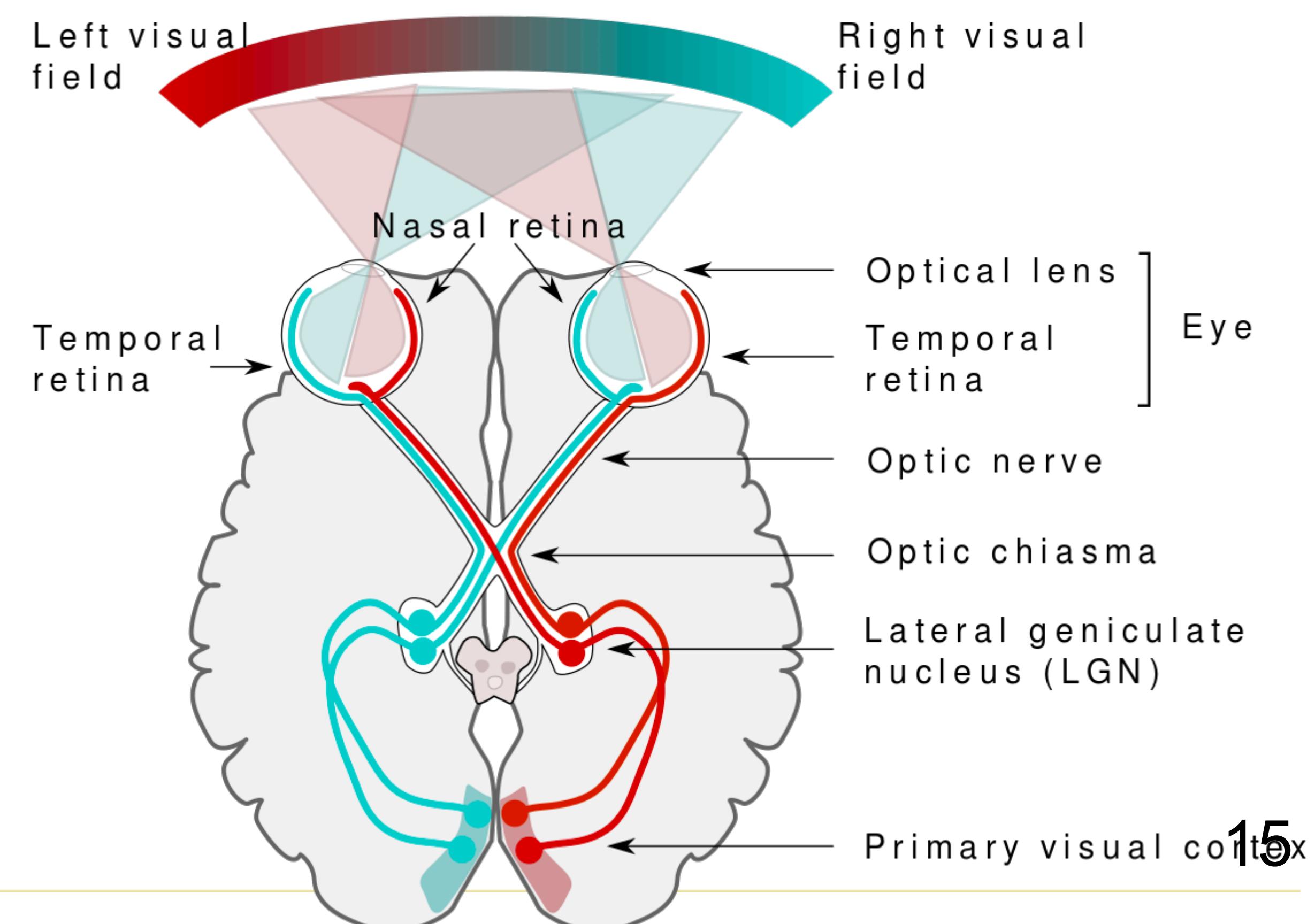
# The network brain

- The cortex is duplicated and the two hemispheres are functionally equivalent
  - The cortex is the highest-level brain processing
  - It controls all our higher human functions, such as planning, thought, language, logic, etc.



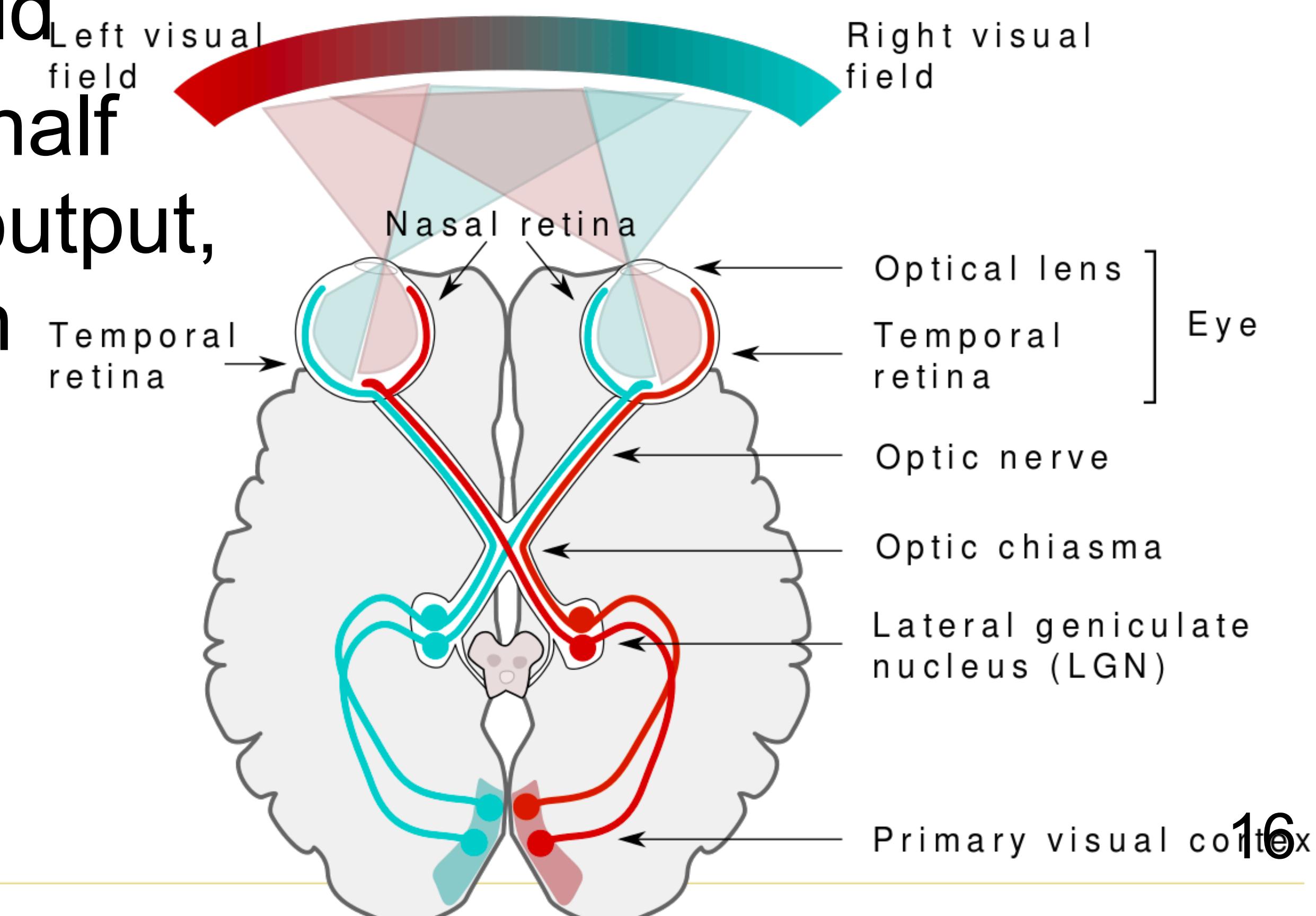
# Sharing the work

- Each hemisphere processes the opposite half of the visual field
  - Left visual field from both eyes goes the right hemisphere
  - Right visual field from both eyes goes the left hemisphere



# Sharing the work

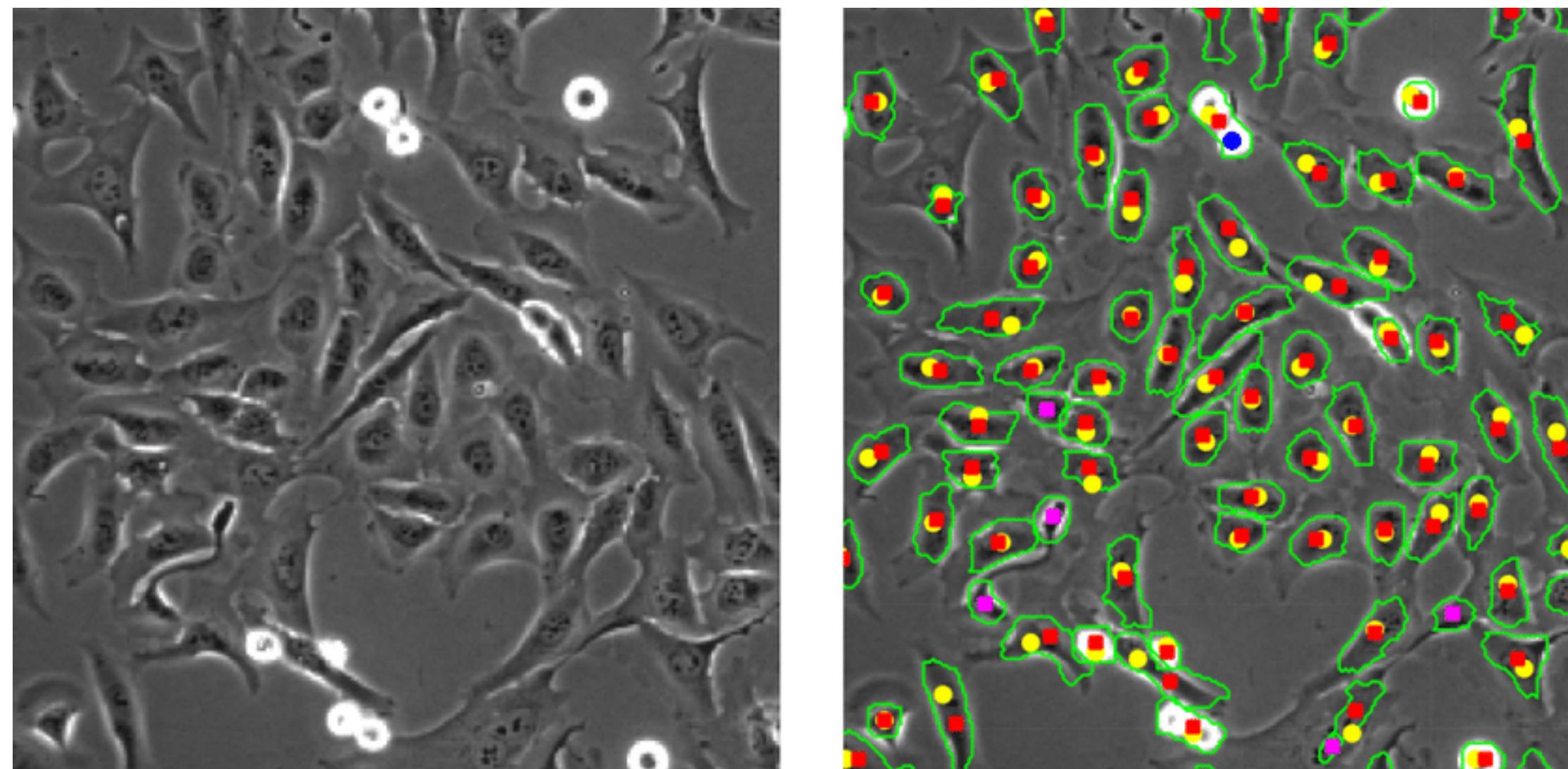
- The brain divides up the visual field
  - Each does half the work but gets all the results
  - The hemispheres share the data by the corpus callosum
  - Both “see” the entire visual field
  - Each hemisphere processes its half adds the other hemisphere’s output, and discrepancies given depth

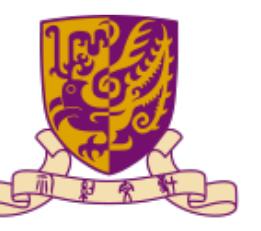


# Human and artificial intelligence

- Towards to general artificial intelligence
  - Get computer to outperform humans on specific tasks, such as detecting cancer cells and recognizing human faces
  - Create intelligent machines to focus on flexibility

How to represent knowledge in machine?



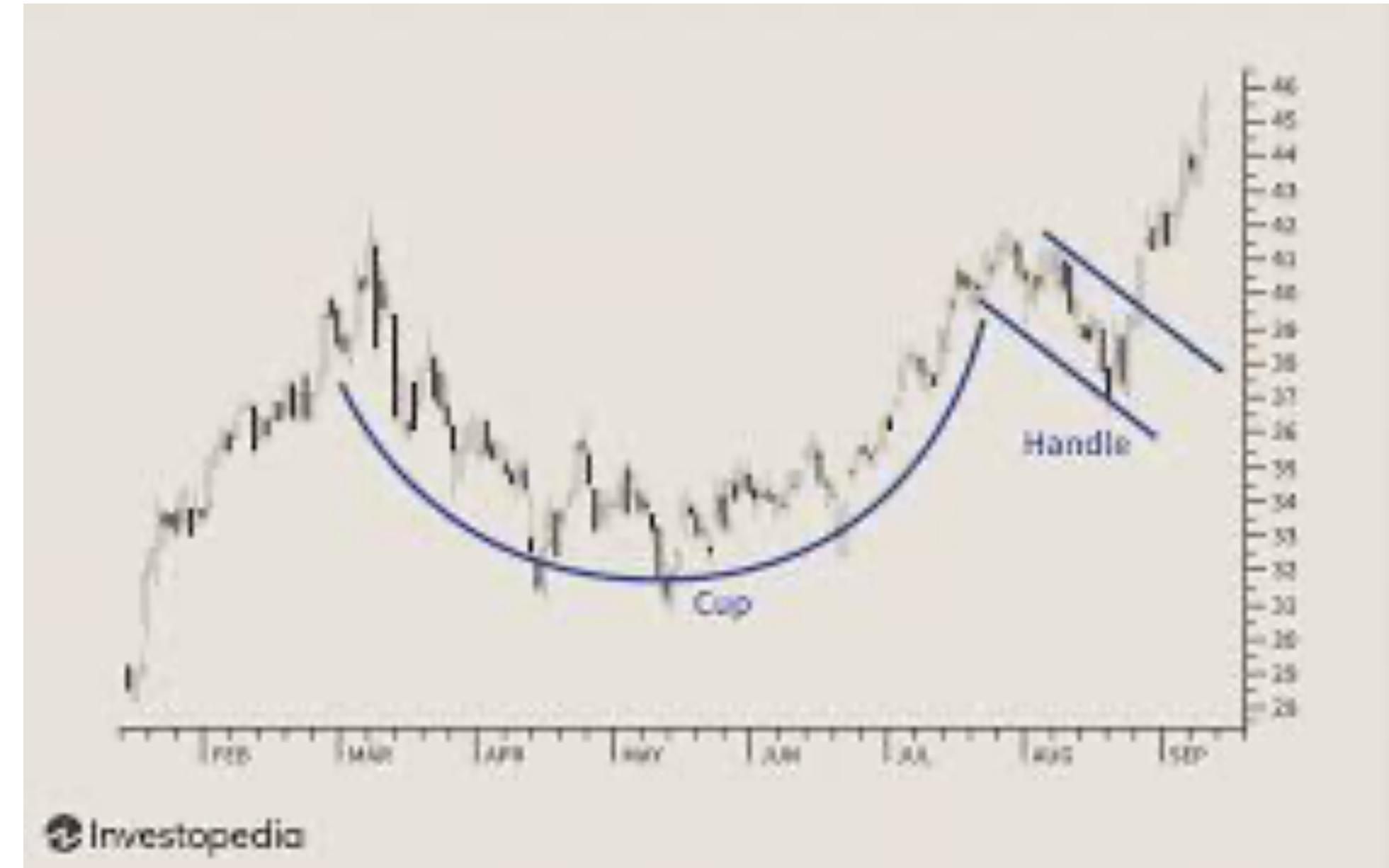


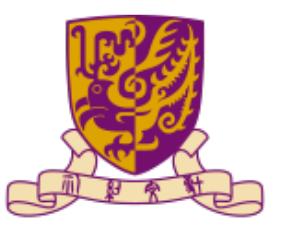
# Human and artificial intelligence

- Four attributes towards general artificial intelligence
  - Learning continuously
  - Learning by movement
  - Many models
  - Using reference frames to store knowledge

How to represent cup in English?

# Human and artificial intelligence





# Outline

- Control
- Information overload
- Simplicity
- Attention flows
- Design notes for attention

# Information overload

- Our visual wetware can handle 600 Mibits/sec, but the world out there was has much more information
- Information overload: when information comes in faster than it can be processed
  - We store it for batch processing later
  - We process information better that way



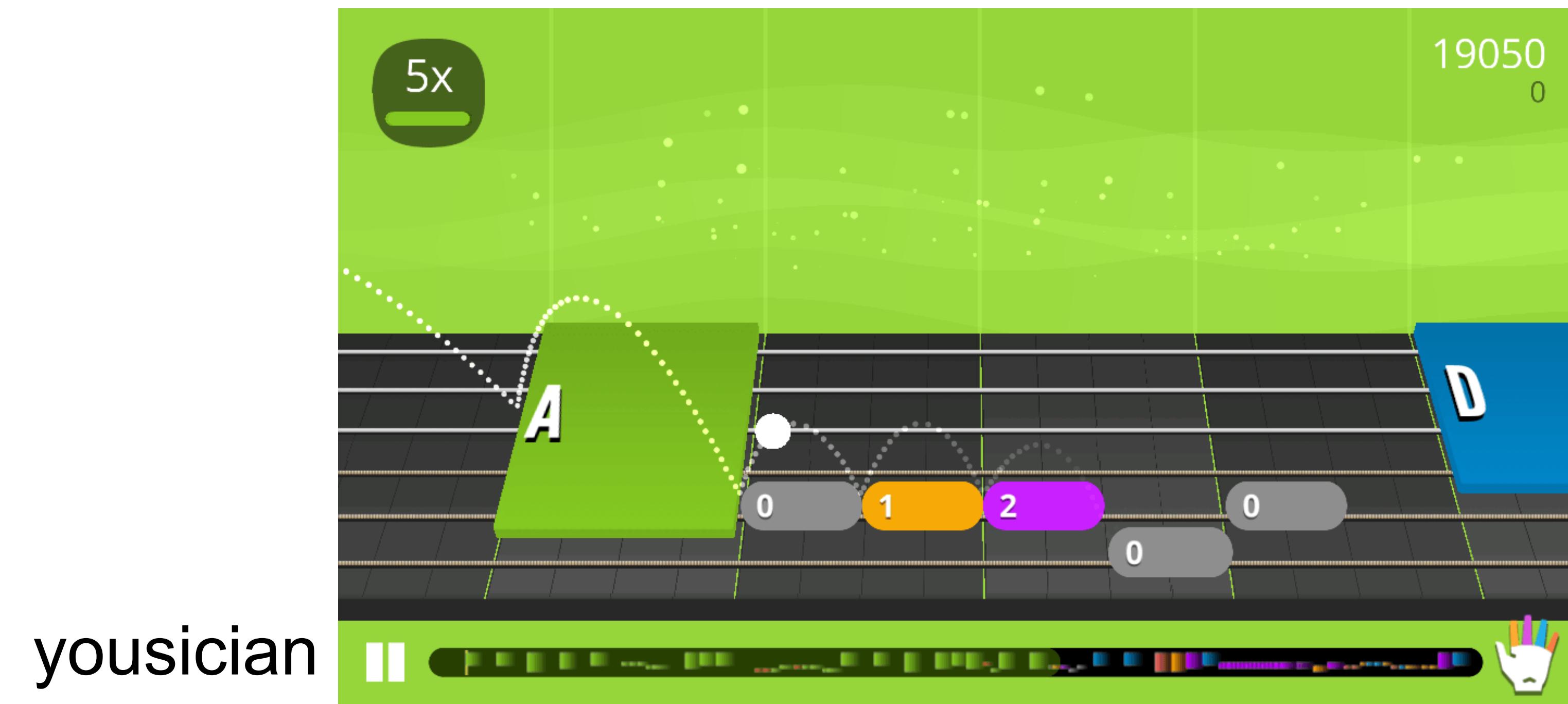
# Information overload

- A newborn baby has
  - Many input channels (senses)
  - That vary over a vast amplitude range
  - With complex spatiotemporal patterns
  - Any one of which can be important



# Information overload

- Is a fact of life that we are used to
- But like the weather, we don't have to suffer it
- Especially for a new web site or app
- Mind-reading technology helps musical learning



# Information overload

- Except 95% of your screen to be initially ignored
  - People have to learn what is important
  - Strategies to deal with information overload fall into two categories
    - ◆ Short-term: strong now, weak later
    - ◆ Long-term: weak now, strong later



# Short-term strategies

- Ignore
  - Like a horse with blinkers
- Panic
  - Do more, work harder
- Run away
  - Leave the field



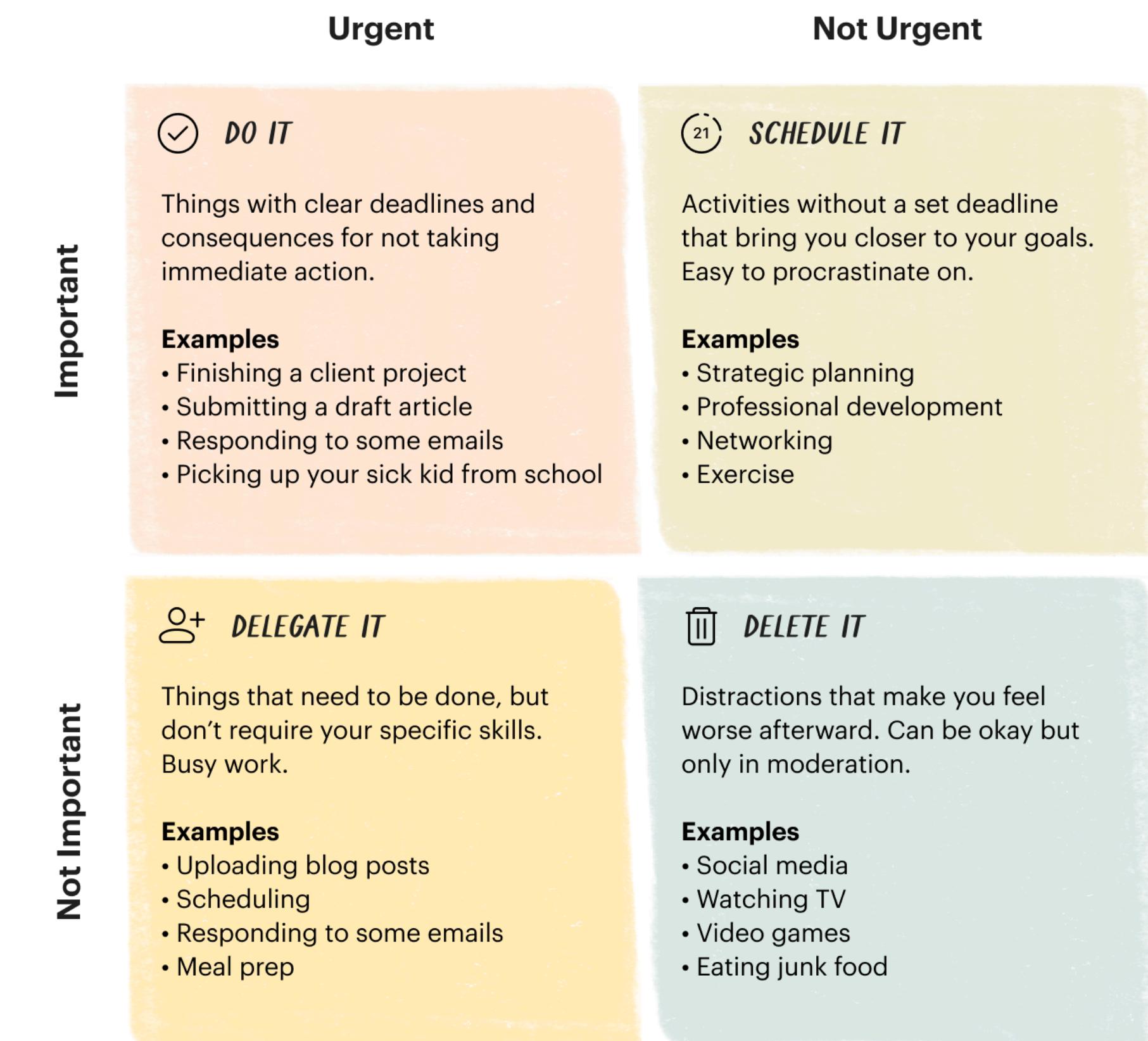
# Short-term strategy problems

- Issues ignored find you
- Doing more of the wrong thing makes it worse
- Problem repeat



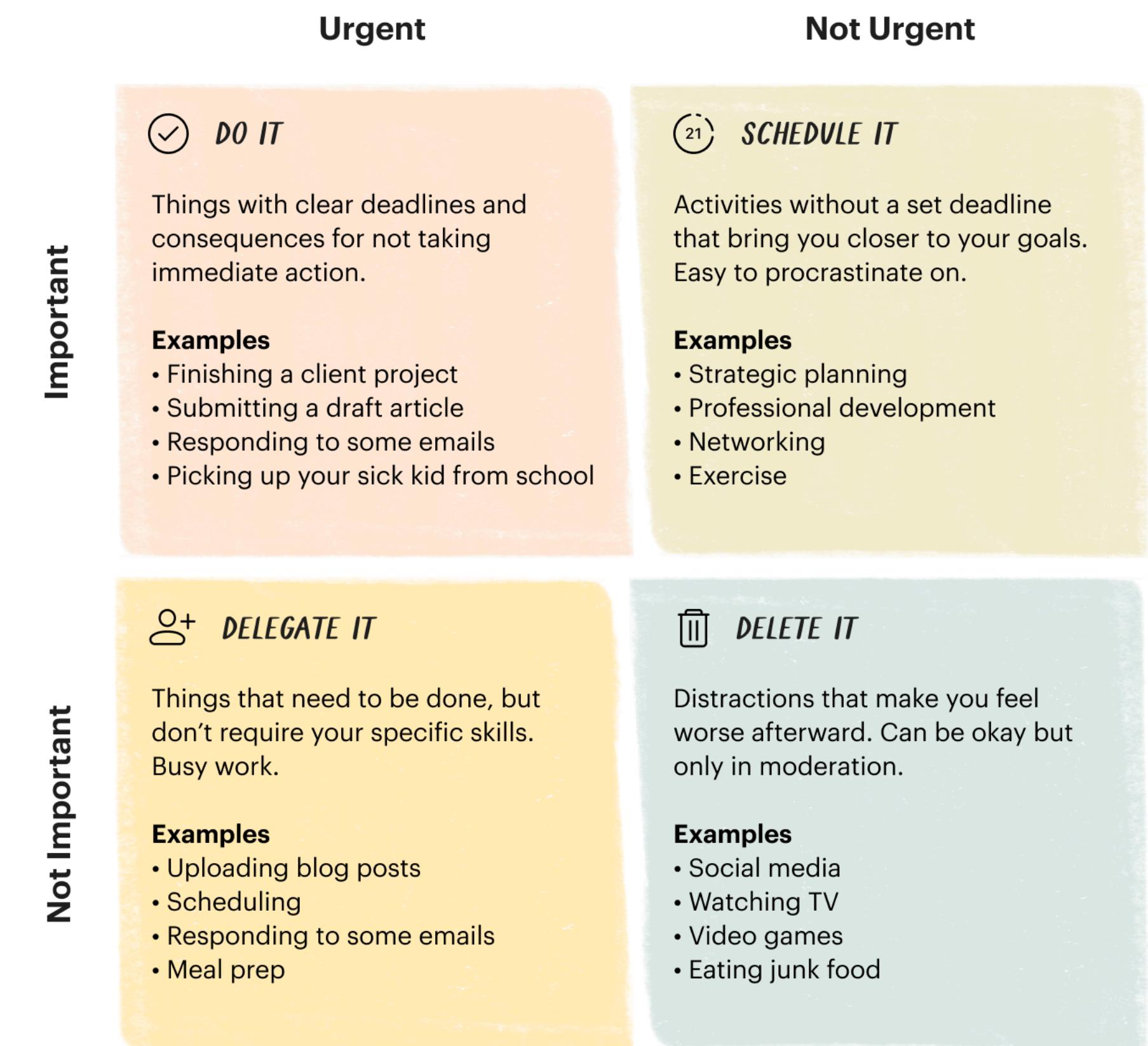
# Long-term strategies

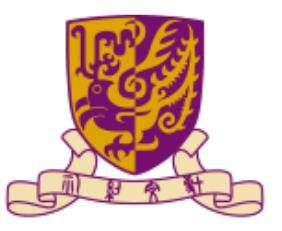
- Discern
  - Important or not? Urgent or not?
- Understand
  - Understand the underlying causes



# Long-term strategy result

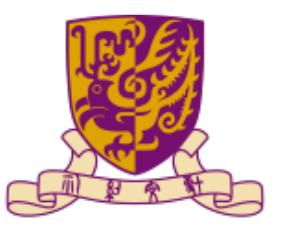
- Allocation
  - Discern relevant from irrelevant (attention)
- Depth
  - Improve understanding of abstract causes





# Short-term design

- Distract: look at this? Buy now!
- Confuse: cheap prices

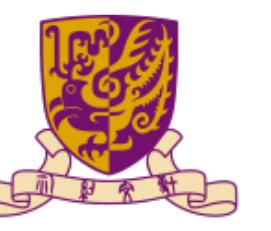


# Short-term design

- Distract: look at this? Buy now!
- Confuse: cheap prices
- Mislead: limited number/time
- Hide: bank charges

# Short-term design

- Distract: look at this? Buy now!
- Confuse: cheap prices
- Mislead: limited number/time
- Hide: bank charges
- Fool: Trump University
- Pretend: That is shoddy product is good
- etc.



# Long-term design

- Prioritize the content you present
  - Put first things first



# Long-term design

- Prioritize the content you present
  - Put first things first
- Simplify early screens
  - Remove everything unnecessary at first
  - Use Just in Time techniques e.g., mouse-over hovers

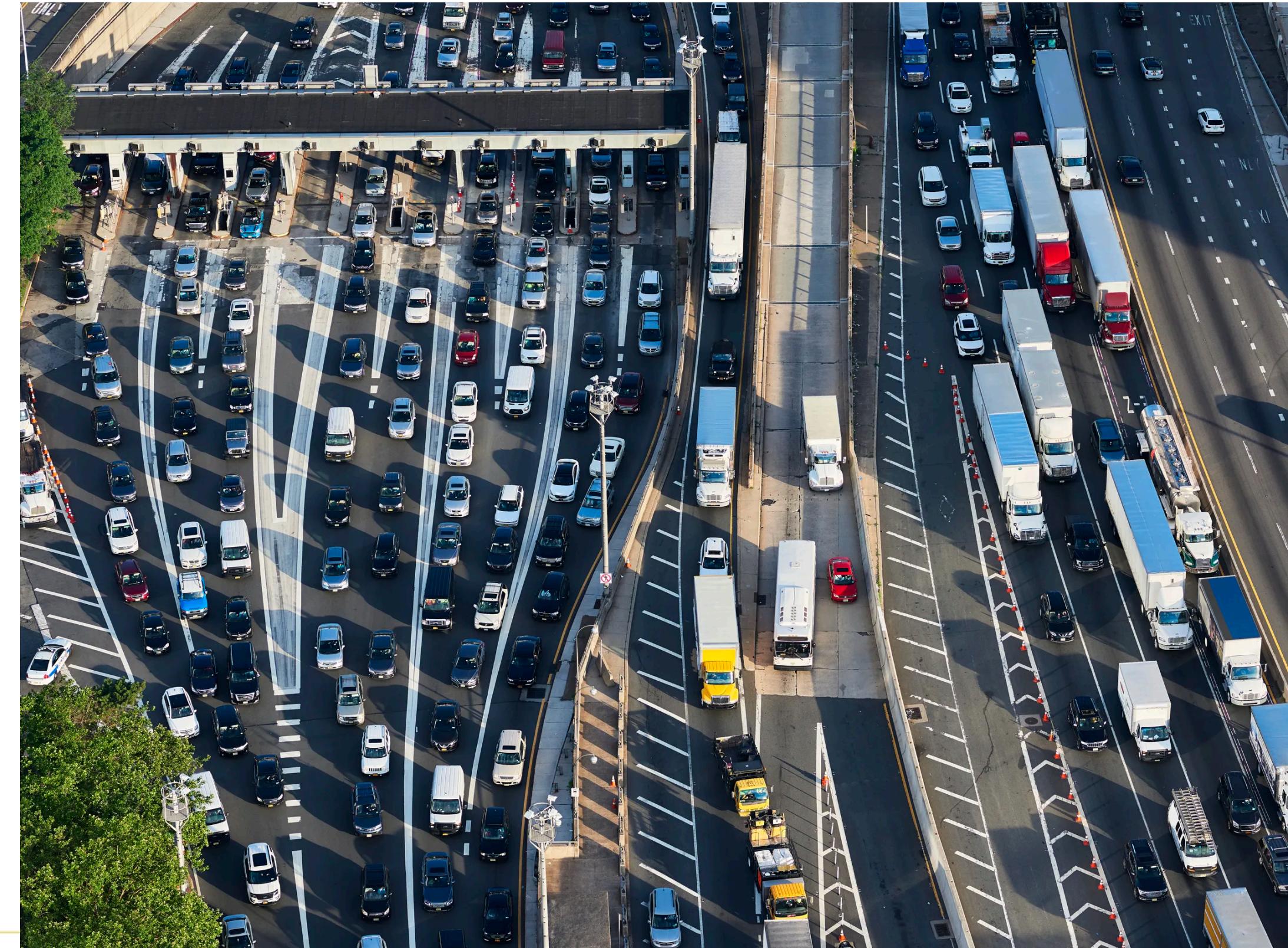


# Long-term design

- Prioritize the content you present
  - Put first things first
- Simplify early screens
  - Remove everything unnecessary at first
  - Use Just in Time techniques e.g., mouse-over hovers
- Direct attention
  - Focus initial attention on the importance
  - Don't hide important things in tiny places
  - What do people want to read/do first

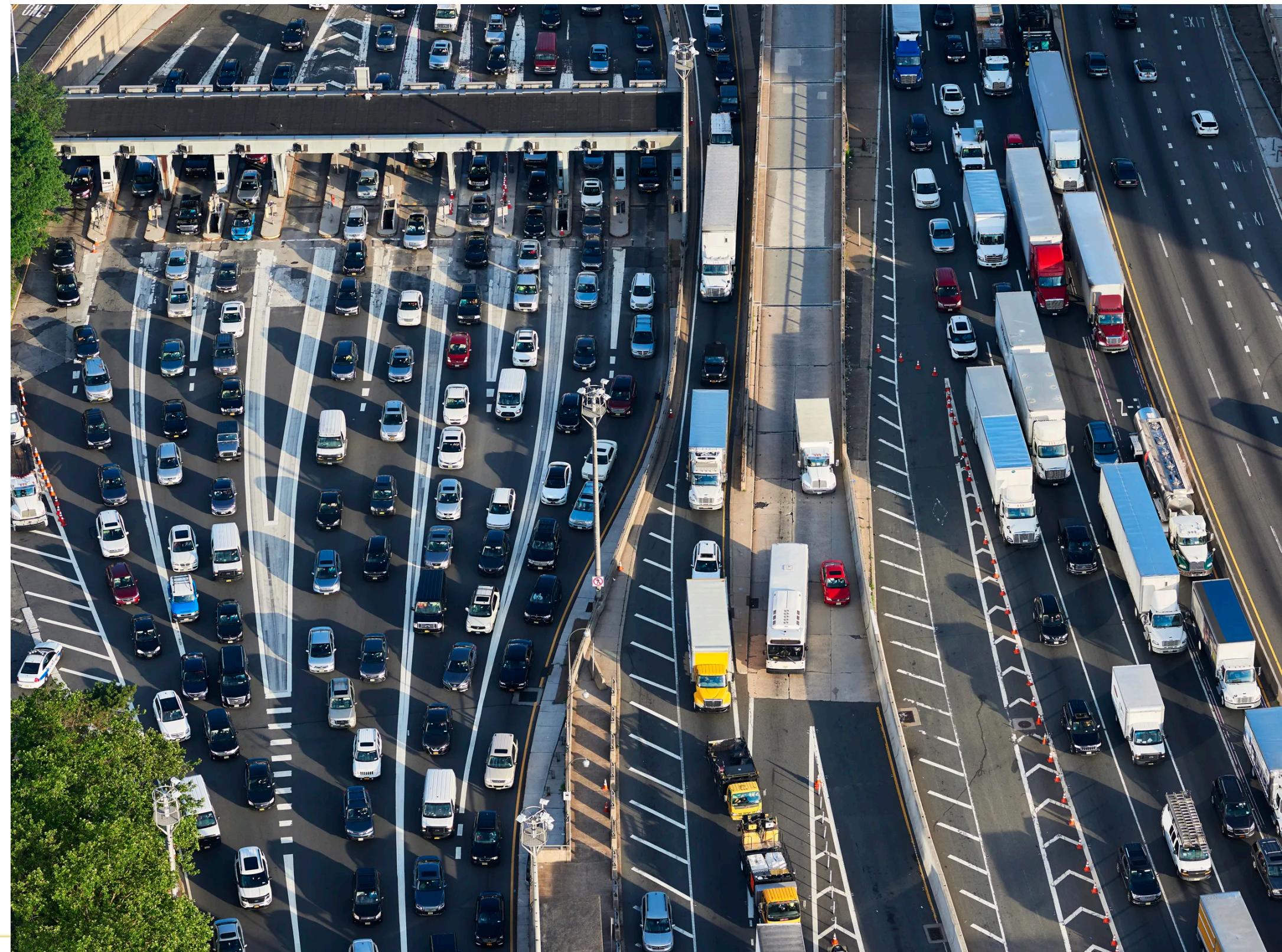
# Driving

- A classic information overload problem
- Reduce as drivers discern situations and understand accident causes
- The main cause of accidents is not speed but inattention



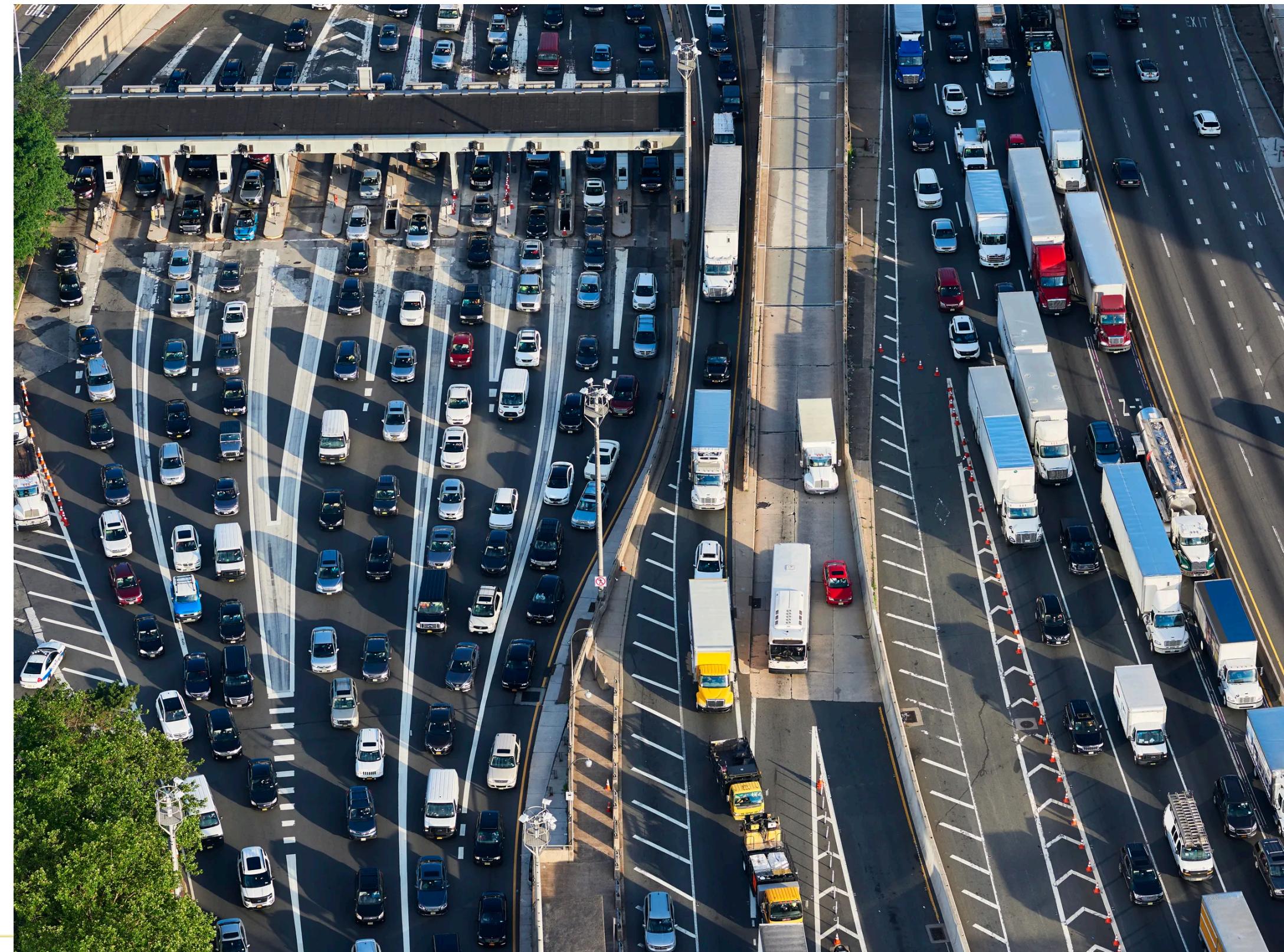
# Driving

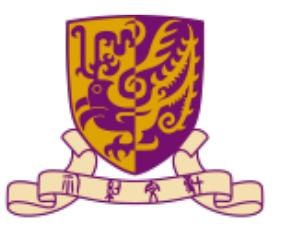
- Recognize the key features of accidents
- Understand situation possibilities



# Driving

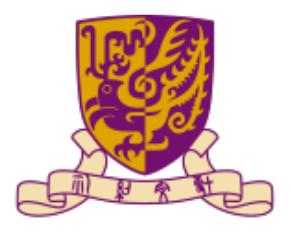
- Experienced drivers see early what novices don't see it until it is too late
- All the warning signs just confuse
- Predictions allows preparation





# Outline

- Control
- Information overload
- **Simplicity**
- Attention flows
- Design notes for attention



# Simplicity

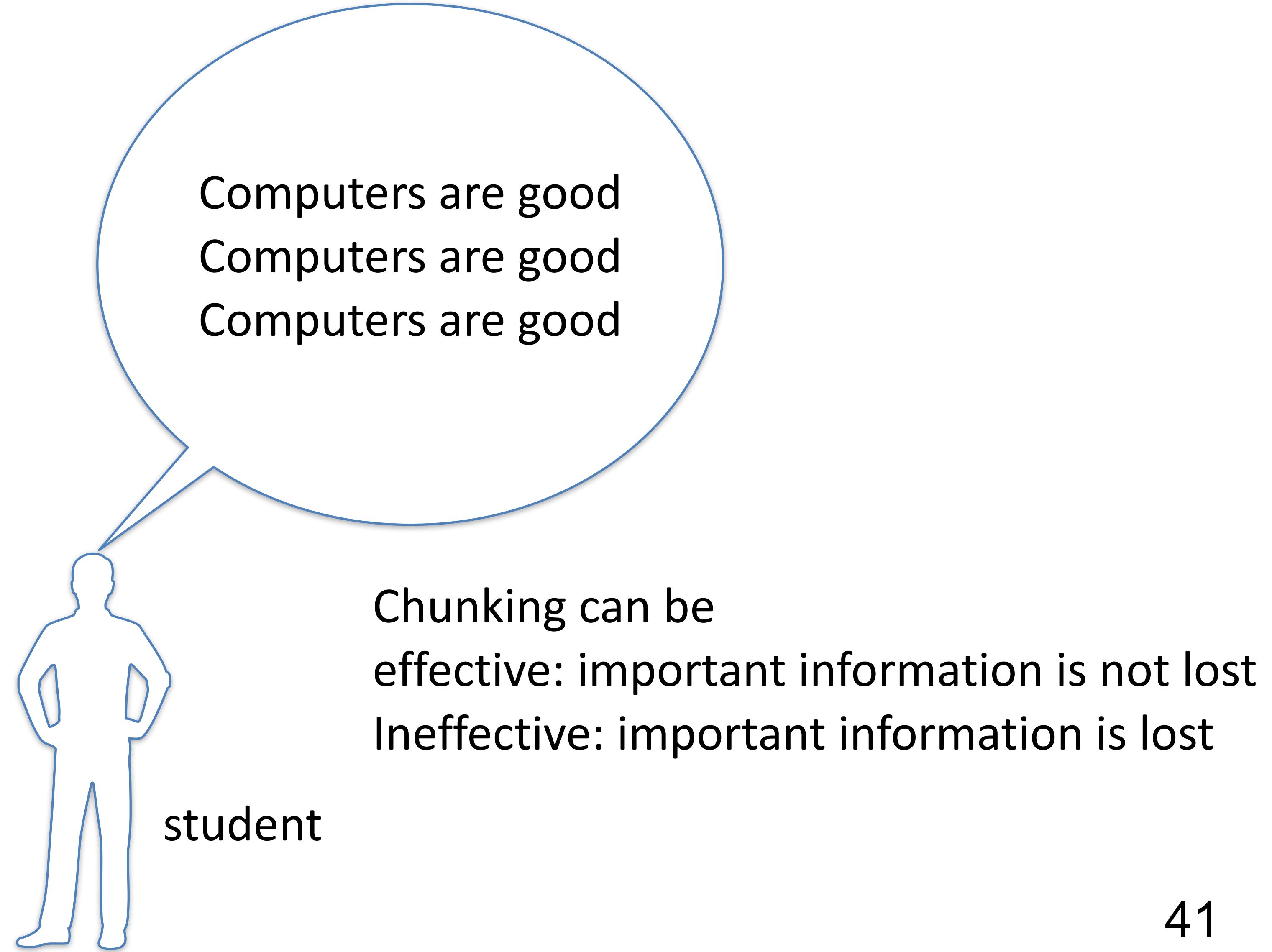
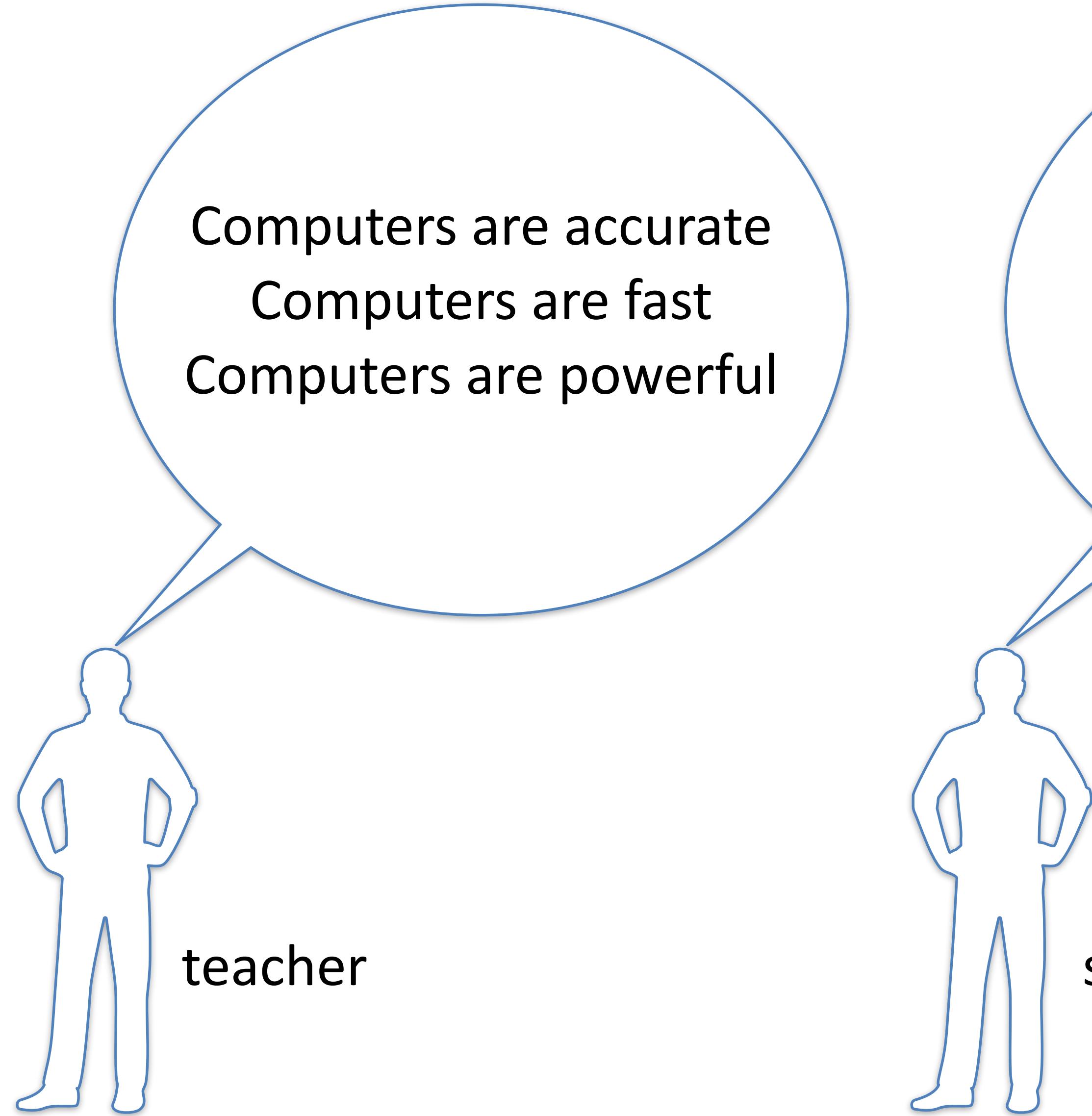
- The brain tries to reduce complexity to simplicity, but in the world entropy (disorder) rules
  - Murphy's law: anything that can go wrong, will go wrong
  - Paranoia: when little signals have big effects

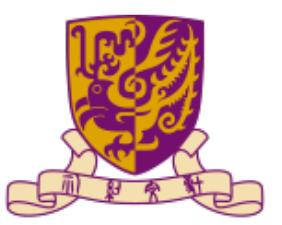
# Chunking

- Make many things one by spacing, color, border, style, size, ect.
  - Improve memory enormously
  - Reduce information overload
- Miller's magic number 7
  - People only reliably remember 4-7 items at once



# Bad chunking





# Outline

- Control
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- **Attention flows**
- Design notes for attention

# Attention reduces overload

- Select 2-5% of information for higher processing
- Process hierarchies choose
  - We focus on one sound among many, one object among many, etc.



# Attention reduces overload

- Problems
  - False expectations: an attention choice error
  - False intuitions: a biology heuristic error

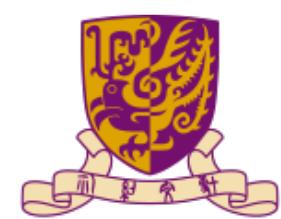


attention error



biology error

# Structured overload



- Obvious information overload is mitigated by
    - Picture plus text
    - Black borders
    - Menu as expected
    - Search function
    - White background
    - Lots of click choices



# Exciting overload

- Shoppers either
  - Know what they want
  - Don't know and browse
- Browsers want variety
  - Supermarket shopping
- Want to people just to click
  - Face makes each click personal
  - White background for title text



# Random overload

- People visit museums for information, not for thrills
  - Too much in the header
- Want people just to click
- Make contact details a click
- Map graphics adds little value
- Non standard main menu



Contact: [007museum@telia.com](mailto:007museum@telia.com) ☎ Phone +004648112960  Open Daily 10-17 (lunch 13-14) Sat 10-14 Donations Media JAMES BOND THEME PARTY Omega Bmw Swatch Bic Bollinger Corgi Posters Specials James Bond store Cd Game PPKGuns Member Guest Links Buy/info

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Welcome to The [James Bond 007 Museum Sweden Nybro Booking open mon-fri 10-17, sat 10-14](#) 



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1. Entr'Hall Information 15. Bar Dry Martin, Champagne Bollinger  
2. Museum Butik/Shop. Exhibition 16. Exit, Nördutgång  
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5. Champagne Bollinger Bar 007 Bond 19. Goldfinger, Aston Martin Vantage 2007,Casino Royale  
6. Computer room PC Dossier Bond 20. Live And Let Die Boat Glastron 190 GT  
7. Bond bathroom models and Tv 21. Gondola from Venice (Moongaker)  
8. Ian Fleming Library/Bibliotek 22. Chess, Room Russia With Love  
9. Hall of James Bond posters 23. Chess, Room Russia With Love  
10. Exhibition cars Jaguar E-Type, BMW 24. Engrave Glass 007 logo  
11. Ian Fleming Library/Bibliotek 25. Exit, Utgång  
12. Roulette, Black Jack room  
13. Gameroom, PS, Gamacube, Nintendo 64  
14. Restaurang/Cafe' Exhibition sign photo

Booking! Call or email [+46\(0\)48112960](tel:+46048112960), [007museum@telia.com](mailto:007museum@telia.com) MAP OVER THE JAMES BOND 007 MUSEUM IN SWEDEN NYBRO over 1000 square meter

# Engage in brain

- A full brain experience lights up the brain more
- Perceptions come after sense level analysis
  - Spatial analyzers create a sense of 3D space from vision, sound, and touch data



# Multi-process

- Example of different perspective
- Space: 3D view
- Movement: a path over time
- Texture: a surface feel e.g., rough or smooth
- Symbols: a shape that revokes a meaning
- Objects: recognize things
- Person: involve relationships
- etc.

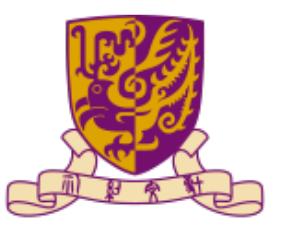
# Boredom

- A bored brain needs something to do
- A brain without input creates it
  - Isolation experiment subjects hallucinate



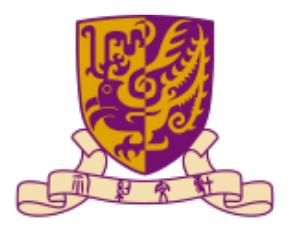
# Boredom

- Individual differences
  - Introvert: low boredom when alone
  - Extrovert: high boredom when alone
  - One person's variety is another's stress



# How to avoid boredom

- Update site and change pictures regularly
- Even the same movie is ignored
- Communicate changes to people
- Boredom causes inattention and inattention causes accidents



# Habituation

- Habituation: constant signal effect decays over time
  - For a steady signal, nerve firing decays with time
    - ◆ It is not due to information overload
    - ◆ We tune out TV ads that repeat
- Dishabituation: the response recovers if the signal stops or changes
  - The more you yell, the less I listen

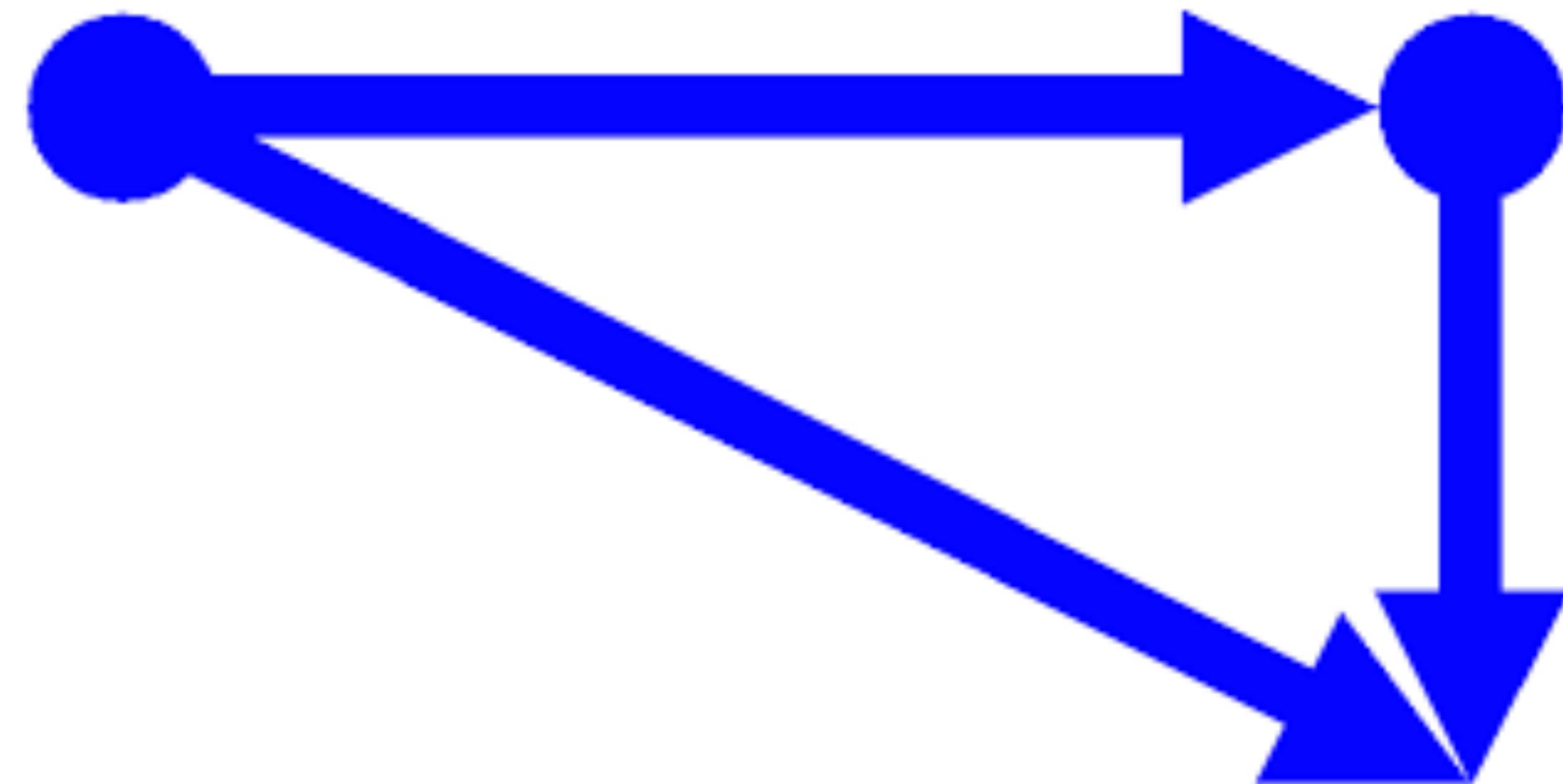
# Change

- A new smell over time fades
  - We don't smell our own group
  - Vegetarians at first smell meat on Westerners
- The brain responds to change, not stimuli
  - Content updates, comments movement. etc.



# Attention flows

- Like a stream but with cultural differences
  - English: from left to right, top to bottom, then front to back
  - Chinese: from top to bottom, left to right, then front to back
  - Arabic: from right to left, top to bottom, then back to front





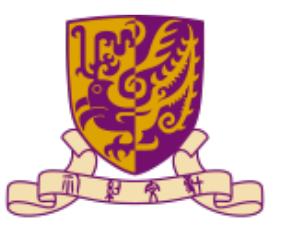
# Attention flows

- By default, eastern attention starts at the top left
  - Put your attention-grabbing photo at the top
  - Put menus at left or top, not bottom, right, o middle
  - Don't put error message at the bottom right
  - Put ads at the bottom or right

# Scan

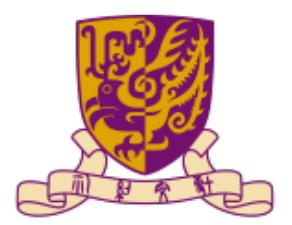
- The visual field isn't processed in one go
- We scan one picture four times
  - Each starting at a point, saccadic movement occurs
  - We scan new images for key features
  - Each icon result like a complete photo
  - But like a buffer, new data wipes out old





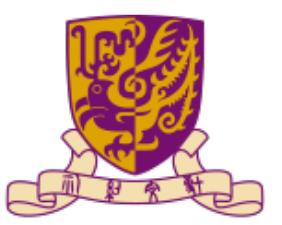
# Scan

- Text is also scanned
  - From word to word, then restart the next line
  - A word is a set of letters and a Space
  - Left-aligned text minimizes scanning
  - Only use centered text for headings or quotes



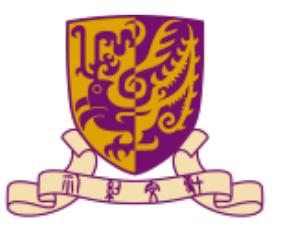
# Attention cues

- Attention evolved to handle danger and opportunity
  - Sudden movements
- Changes
- Emotional things
- Unusual things



# Outline

- Control
- Information overload
- Simplicity
- Attention flows
- Design notes for attention



# Designer notes: attention

- Simplify
- Focus
- Invite
- Chunk
- Prioritize
- Engage the brain



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# Simplify

About Store

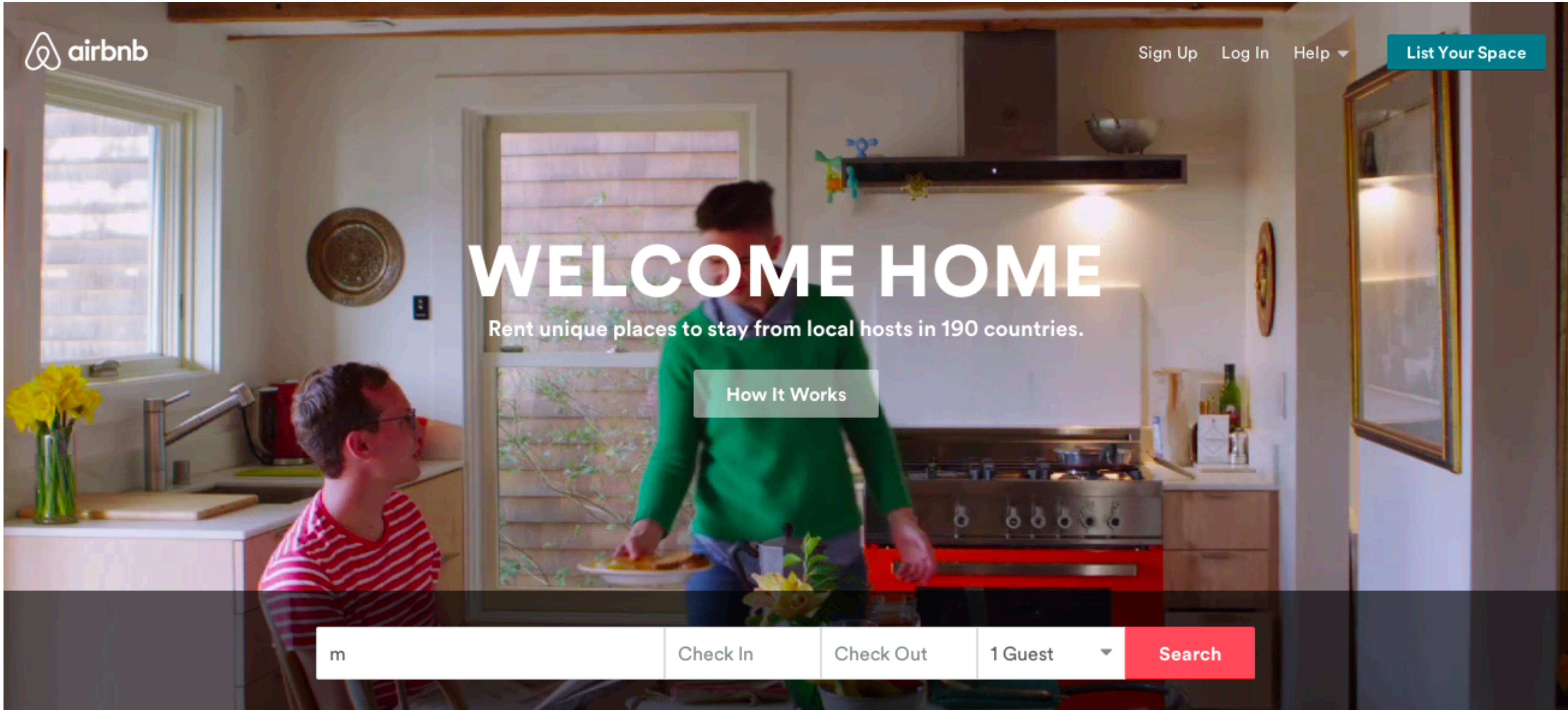
Gmail Images



Sign in

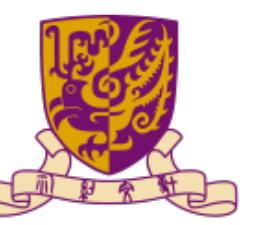
# Google

# Focus



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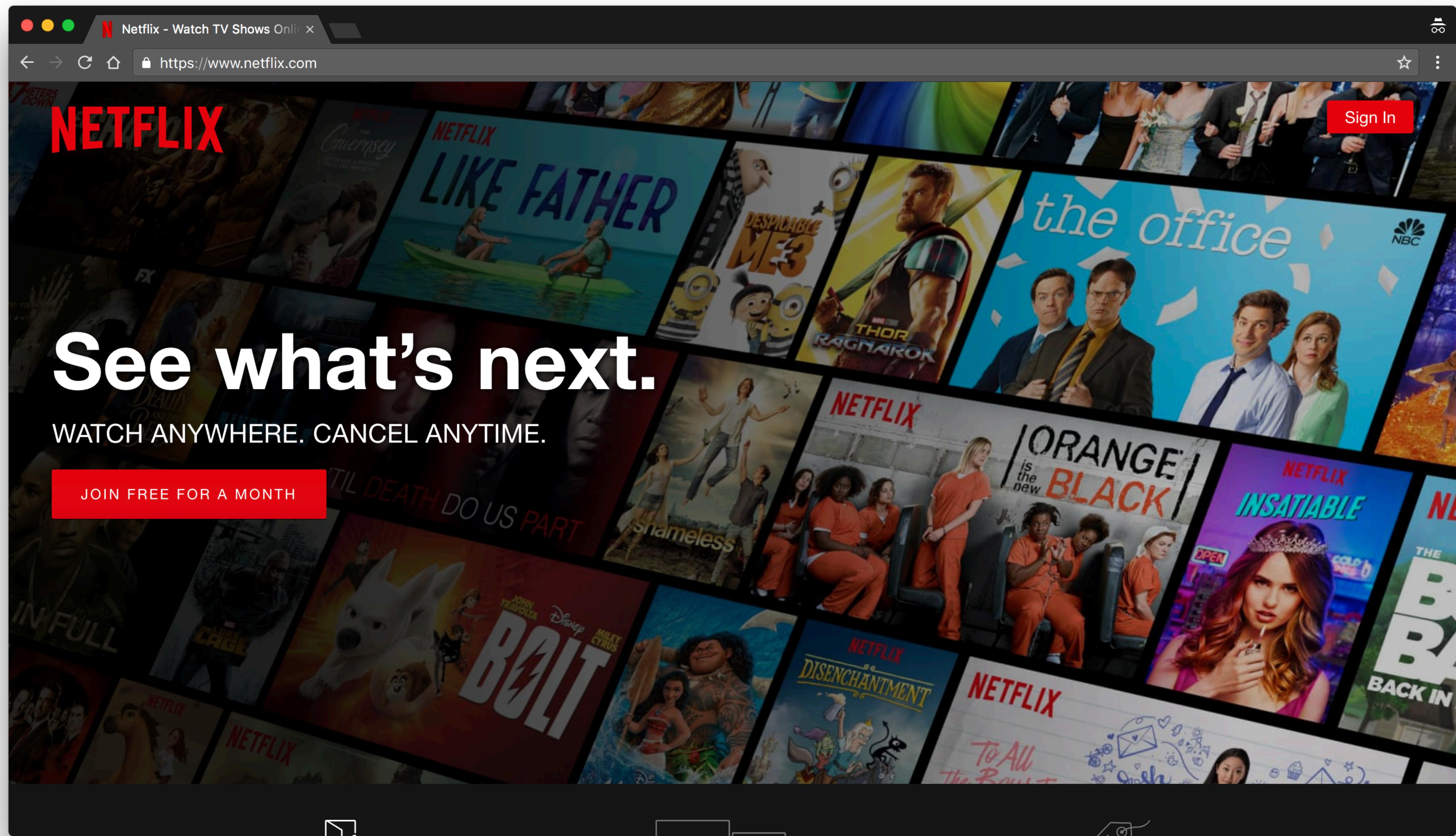
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# Chunking

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# Prioritize

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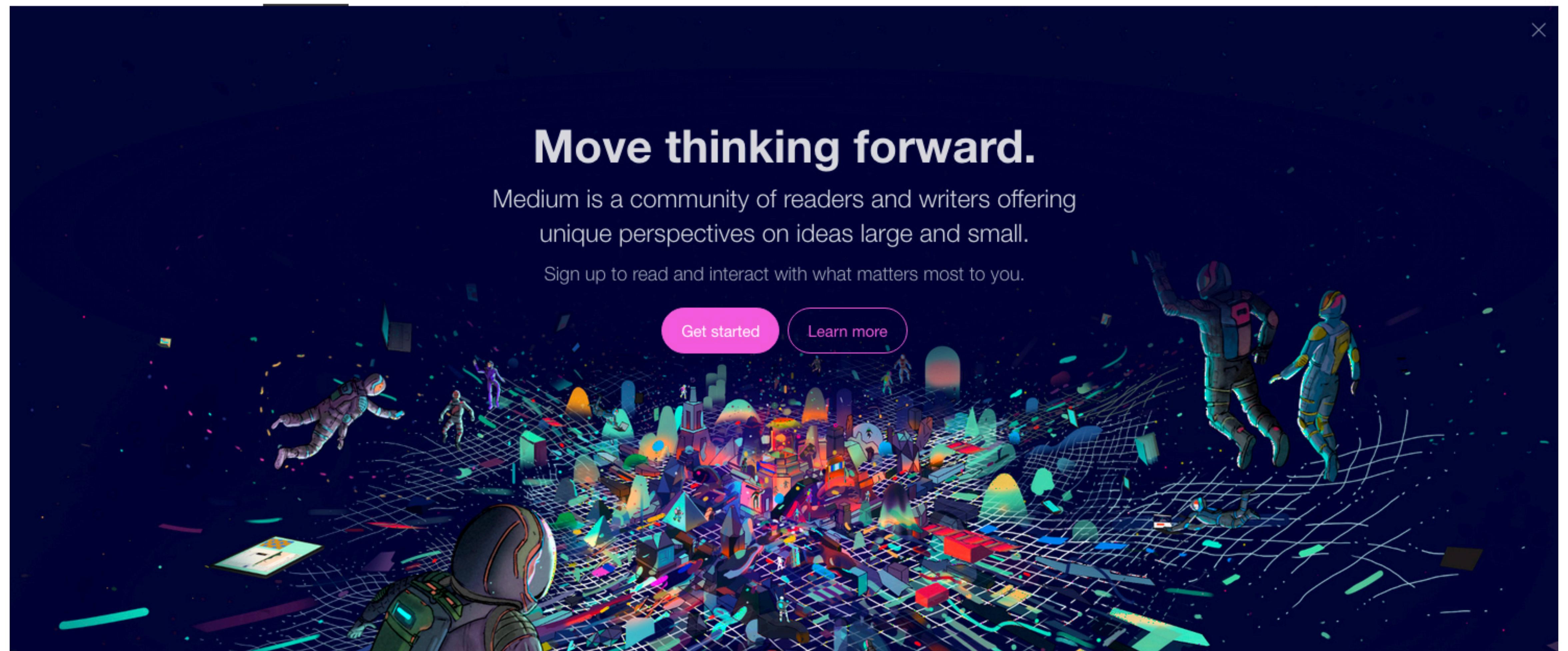
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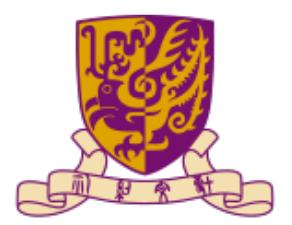


Engage the brain



# Reduce information overload

- Consider the information relevant to a visitor
- Important questions include
  - Who visits the site/app
  - What do they want to do
  - What information do they want first
  - What information do they want next
  - How can information be chunked
  - ect.



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**Thank Prof. Brian Whitworth for many of the slides!**