CS10
The Beauty and Joy of Computing

UC Berkeley
Computer Science
Summer Instructor
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Lecture #1
Welcome; Abstraction

2012-06-15

CS10 : YOU'LL LOVE IT!

Watch the student testimonials about CS10, what it means to them, and how it has changed their lives. Inspiring!

inst.eecs.berkeley.edu/~cs10/

CS10 in one slide

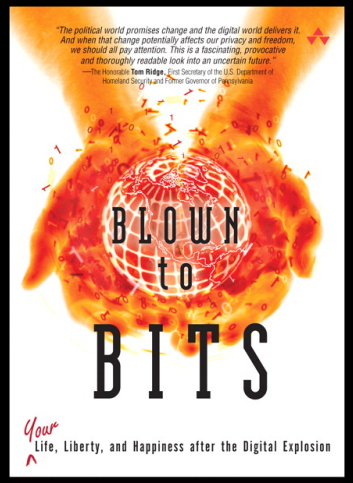
- **Big Ideas of Programming**
  - Abstraction
  - Algorithms (2)
  - Recursion (2)
  - Functions-as-data, λ (2)
  - *Programming Paradigms*
  - *Concurrency*
  - *Distributed Computing*
- **Beauty and Joy**
  - "CS Unplugged" activities
  - All lab work in pairs
  - Two projects in pairs
    - Of your own choice!
  - One blog
    - Of your' own choice!
- **Big Ideas of Computing**
  - HowStuffWorks
    - 3D Graphics
    - Video Games
    - Computational Game Theory
  - Research Summaries
    - AI
    - HCI
  - Apps that Changed the World
  - Social Implications of Computing
  - Saving the World with Computing
  - How Twitter Works (guest lecture)
  - Cloud Computing
  - Limits of Computing
  - Future of Computing

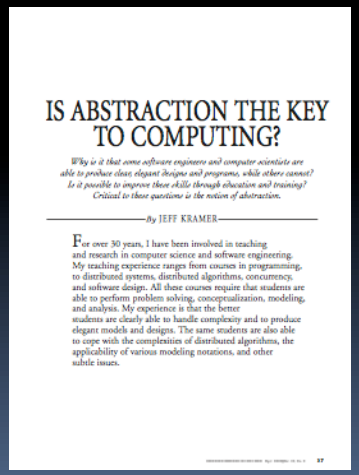
Format & Textbooks

- **Format (14 hrs/wk * 8 wks)**

M	Tu	W	Th
Lab		Lab	
Disc		Disc	
Lec	Lec	Lec	Lec

- **Selected Reading**
  - Taken from great book ("Blown to Bits" by Abelson, Ledeen & Lewis) + articles + videos
  - Current events EVERY DAY (e.g., IBM's Watson vs Jeopardy)
- **All resources FREE**
  - Even clickers!





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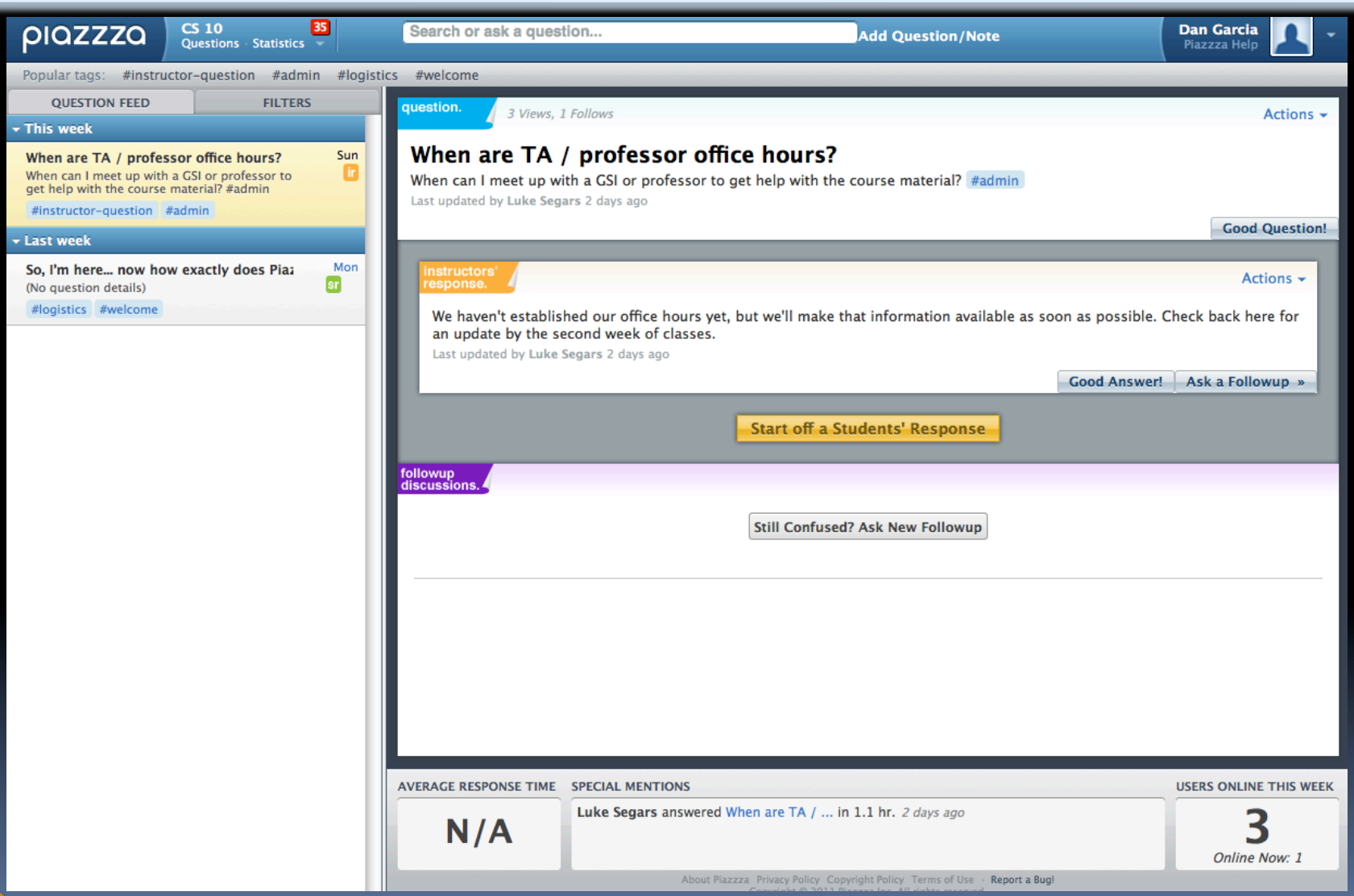
Peer Instruction

- Increase real-time learning in lecture, test understanding of concepts vs. details
- As we complete a "segment" we ask multiple choice question
  - 1-2 minutes to decide yourself
  - 2 minutes in pairs/triples to reach consensus. Teach others!
  - 2 minute discussion of answers, questions, clarifications

Piazza for {ask,answer}ing questions



Grading

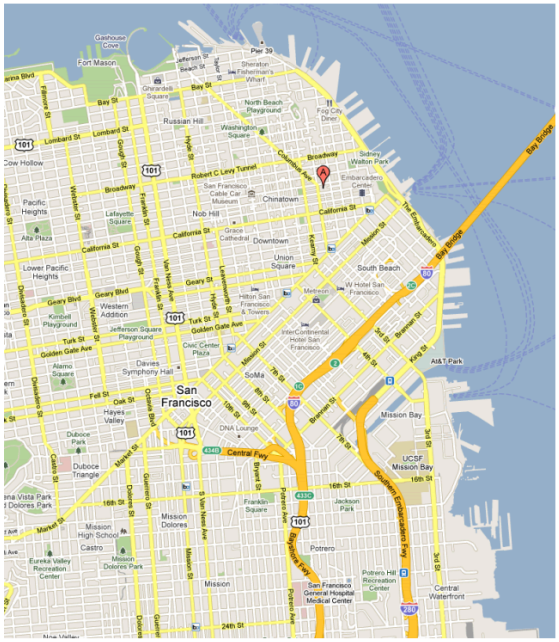
- **EPA**
  - Effort
  - Participation
  - Altruism
- **Not Competitive**
  - Absolute Grading (No Curve, No Limit on A's)
- **Course Historical Average = B/B+**
  - CS Department Average = B-

Abstraction

- **Detail removal**
  - "The act or process of leaving out of consideration one or more properties of a complex object so as to attend to others."
- **Generalization**
  - "The process of formulating general concepts by abstracting common properties of instances"

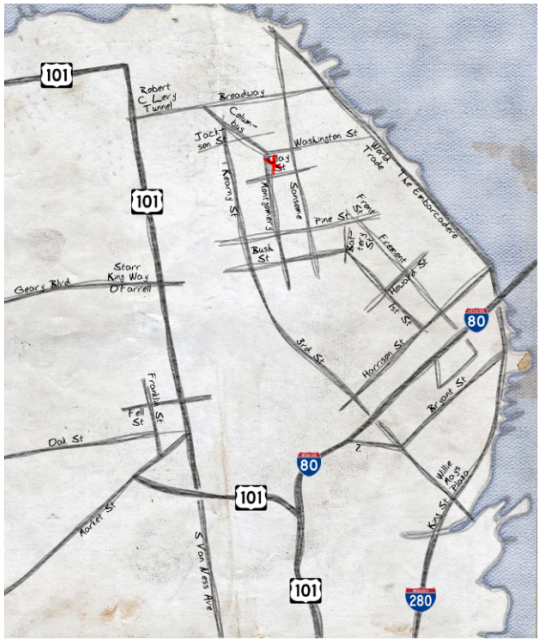
Henri Matisse *"Naked Blue IV"*

Detail Removal



General Purpose Online Map

Selected Roads



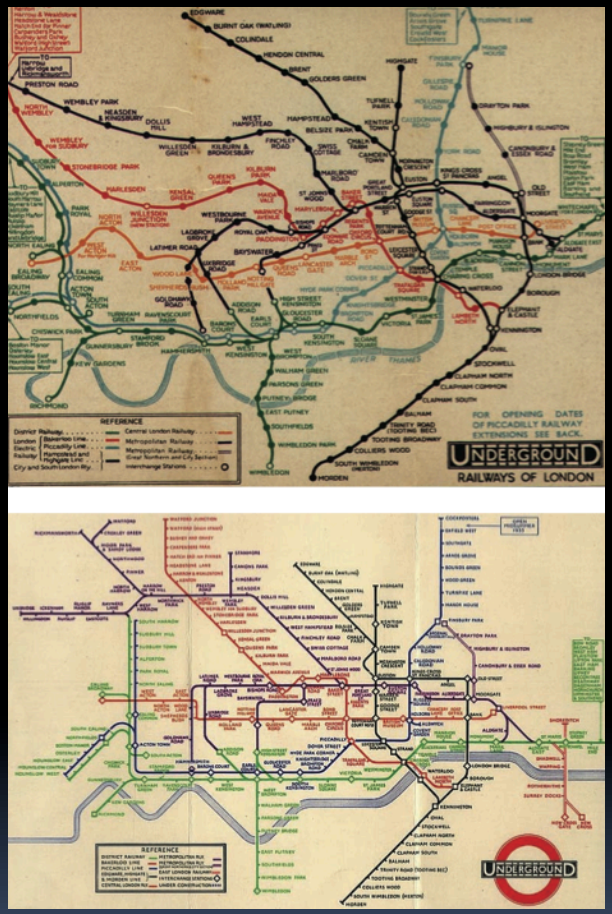
Our Result

Automatic Generation of Detail Maps

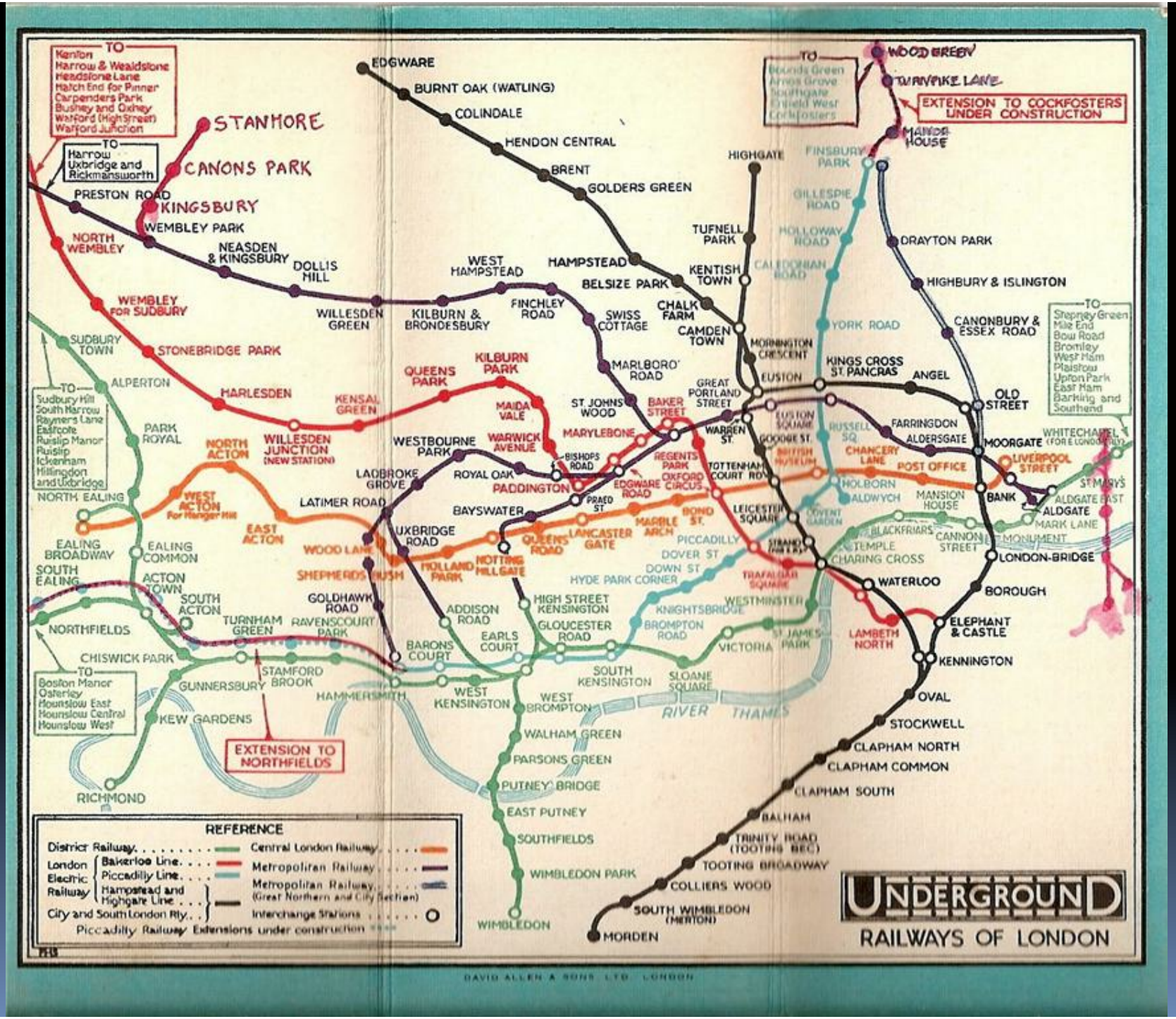
Maneesh Agrawala (UCB EECS), among others

Detail Removal (in CS10)

- You'll want to write a project to **simulate a real-world situation**, or play a game, or …
- Abstraction is the idea that you **focus on the essence**, the cleanest way to map the messy real world to one you can build



The London Underground 1928 Map & the 1933 map by Harry Beck.


TO
Kenton
Harrow & Wealdstone
Headstone Lane
Hatch End for Pinner
Carpenders Park
Bushey and Oxhey
Watford (High Street)
Watford Junction
TO
Harrow
Uxbridge and
Rickmansworth
STANMORE
CANONS PARK
KINGSBURY
PRESTON ROAD
WEMBLEY PARK
NORTH WEMBLEY
NEASDEN
& KINGSBURY
DOLLIS HILL
WEMBLEY FOR SUDBURY
WILLESDEN GREEN
KILBURN & BRONDESBURY
WEST HAMPSTEAD
FINCHLEY ROAD
SWISS COTTAGE
HAMPSTEAD
BELSIZE PARK
CHALK FARM
CAMDEN TOWN
KENTISH TOWN
EDGWARE
BURNT OAK (WATLING)
COLINDALE
HENDON CENTRAL
BRENT
GOLDERS GREEN
HIGHGATE
TUFNELL PARK
TO
Bounds Green
Arnos Grove
Southgate
Enfield West
Cockfosters
WOOD GREEN
TURNPIKE LANE
EXTENSION TO COCKFOSTERS UNDER CONSTRUCTION
MANOR HOUSE
FINSBURY PARK
GILLESPIE ROAD
HOLLOWAY ROAD
CALEDONIAN ROAD
DRAYTON PARK
HIGHBURY & ISLINGTON
YORK ROAD
CANONBURY & ESSEX ROAD
TO
Shepherd's Green
Mile End
Bow Road
Bromley
West Ham
Plaistow
Upton Park
East Ham
Barking and
Southend
SUDBURY TOWN
STONEBRIDGE PARK
HARLESDEN
KENSAL GREEN
QUEENS PARK
KILBURN PARK
MAIDA VALE
ST JOHNS WOOD
MARLBORO' ROAD
MORNINGTON CRESCENT
EUSTON
GREAT PORTLAND STREET
BAKER STREET
KINGS CROSS ST. PANCRAS
ANGEL
OLD STREET
TO
Sudbury Hill
South Harrow
Rayners Lane
Eastcote
Ruislip Manor
Ruislip
Ickenham
Hillingdon
and Uxbridge
ALPERTON
PARK ROYAL
NORTH ACTON
WILLESDEN JUNCTION (NEW STATION)
WESTBOURNE PARK
WARWICK AVENUE
MARYLEBONE
EUSTON SQUARE
GOODGE ST.
RUSSELL SQ.
FARRINGDON
ALDERSGATE
MOORGATE
LIVERPOOL STREET
WHITECHAPEL (FOR E. LONDON RLY.)
BISHOPS ROAD
REGENTS PARK
BRITISH MUSEUM
CHANCERY LANE
POST OFFICE
LADBROKE GROVE
ROYAL OAK
PADDINGTON
EDGWARE ROAD
OXFORD CIRCUS
TOTTENHAM COURT RD.
HOLBORN
ALDWYCH
MANSION HOUSE
BANK
ST. MARY'S
ALDGATE EAST
ALDGATE
MARK LANE
NORTH EALING
WEST ACTON
For Hanger Hill
LATIMER ROAD
BAYSWATER
PRAED ST.
MARBLE ARCH
BOND ST.
LEICESTER SQUARE
COVENT GARDEN
EAST ACTON
UXBRIDGE ROAD
QUEENS ROAD
LANCASTER GATE
PICCADILLY
STRAND
BLACKFRIARS
CANNON STREET
MONUMENT
EALING BROADWAY
EALING COMMON
WOOD LANE
HOLLAND PARK
NOTTING HILL GATE
DOVER ST
TEMPLE
CHARING CROSS
LONDON-BRIDGE
SOUTH EALING
ACTON TOWN
SHEPHERDS BUSH
HYDE PARK CORNER
DOWN ST
TRAFALGAR SQUARE
WATERLOO
BOROUGH
SOUTH ACTON
GOLDHAWK ROAD
HIGH STREET KENSINGTON
WESTMINSTER
KNIGHTSBRIDGE
NORTHFIELDS
TURNHAM GREEN
RAVENSCOURT PARK
ADDISON ROAD
GLOUCESTER ROAD
BROMPTON ROAD
ST JAMES' PARK
LAMBETH NORTH
ELEPHANT & CASTLE
CHISWICK PARK
BARONS COURT
EARLS COURT
VICTORIA
KENNINGTON
TO
Boston Manor
Osterley
Hounslow East
Hounslow Central
Hounslow West
STAMFORD BROOK
SOUTH KENSINGTON
SLOANE SQUARE
GUNNERSBURY
HAMMERSMITH
WEST KENSINGTON
WEST BROMPTON
OVAL
KEW GARDENS
RIVER THAMES
STOCKWELL
EXTENSION TO NORTHFIELDS
WALHAM GREEN
CLAPHAM NORTH
PARSONS GREEN
CLAPHAM COMMON
PUTNEY BRIDGE
CLAPHAM SOUTH
RICHMOND
EAST PUTNEY
BALHAM
SOUTHFIELDS
TRINITY ROAD (TOOTING BEC)
TOOTING BROADWAY
WIMBLEDON PARK
COLLIERS WOOD
SOUTH WIMBLEDON (MERTON)
WIMBLEDON
MORDEN
REFERENCE
District Railway
London Electric Railway
Bakerloo Line
Piccadilly Line
Hampstead and Highgate Line
City and South London Rly.
Central London Railway
Metropolitan Railway
Metropolitan Railway (Great Northern and City Section)
Interchange Stations
Piccadilly Railway Extensions under construction
UNDERGROUND
RAILWAYS OF LONDON
DAVID ALLEN & SONS LTD. LONDON


OPEN MIDSUMMER 1933
COCKFOSTERS
ENFIELD WEST
SOUTHGATE
ARNOS GROVE
BOUNDS GREEN
WOOD GREEN
TURNPIKE LANE
MANOR HOUSE
FINSBURY PARK
ARSENAL
DRAYTON PARK
HIGHBURY & ISLINGTON
CANONBURY & ESSEX ROAD
TO
BOW ROAD
BROMLEY
WEST HAM
PLAISTOW
UPTON PARK
EAST HAM
BARKING
UPNEY
BECONTREE
HEATHWAY
DAGENHAM
HORNCHURCH
UPMINSTER
& SOUTHEND
HIGHGATE
TUFNELL PARK
KENTISH TOWN
CAMDEN TOWN
MORNINGTON CRESCENT
EUSTON
KINGS CROSS ST. PANCRAS
HOLLOWAY ROAD
CALEDONIAN ROAD
OLD STREET
ANGEL
MOORGATE
LIVERPOOL STREET
BANK
ALDWYCH
COVENT GARDEN
MANSION HOUSE
MONUMENT
ALDGATE
SHOREDITCH
STEPNEY GREEN
WHITECHAPEL
MILE END
ST. MARYS
ALDGATE EAST
MARK LANE
BLACKFRIARS
CANNON STREET
TEMPLE
CHARING CROSS
STRAND
LEICESTER SQUARE
TRAFALGAR SQUARE
WESTMINSTER
VICTORIA
WATERLOO
LONDON BRIDGE
BOROUGH
ELEPHANT & CASTLE
LAMBETH NORTH
KENNINGTON
OVAL
STOCKWELL
CLAPHAM NORTH
CLAPHAM COMMON
CLAPHAM SOUTH
BALHAM
TRINITY ROAD (TOOTING BEC)
TOOTING BROADWAY
COLLIERS WOOD
SOUTH WIMBLEDON (MERTON)
MORDEN
SHADWELL
WAPPING
ROTHERHITHE
SURREY DOCKS
NEW CROSS GATE
NEW CROSS
WATFORD
RICKMANSWORTH
CROXLEY GREEN
MOOR PARK & SANDY LODGE
NORTHWOOD
PINNER
WATFORD JUNCTION
WATFORD (HIGH STREET)
BUSHEY AND OXHEY
CARPENDERS PARK
HATCH END for PINNER
HEADSTONE LANE
HARROW & WEALDSTONE
KENTON
STANMORE
CANONS PARK
KINGSBURY
NEASDEN
DOLLIS HILL
WILLESDEN GREEN
KILBURN & BRONDESBURY
WEST HAMPSTEAD
FINCHLEY ROAD
SWISS COTTAGE
MARLBORO ROAD
ST JOHNS WOOD
MARYLEBONE
EDGWARE
BURNT OAK (WATLING)
COLINDALE
HENDON CENTRAL
BRENT
GOLDERS GREEN
HAMPSTEAD
BELSIZE PARK
CHALK FARM
NORTH HARROW
HARROW ON THE HILL
PRESTON ROAD
NORTHWICK PARK
NORTH WEMBLEY
WEMBLEY PARK
WEMBLEY for SUDBURY
STONEBRIDGE PARK
HARLESDEN
WILLESDEN JUNCTION
KENSAL GREEN
QUEENS PARK
KILBURN PARK
MAIDA VALE
WARWICK AVENUE
UXBRIDGE
ICKENHAM
RUISLIP MANOR
RAYNERS LANE
WEST HARROW
HILLINGDON
RUISLIP
EASTCOTE
SOUTH HARROW
SUDBURY HILL
SUDBURY TOWN
ALPERTON
PARK ROYAL
NORTH EALING
EALING BROADWAY
WEST ACTON
EAST ACTON
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WARREN STREET
GOODGE STREET
FARRINGDON
ALDERSGATE
RUSSELL SQUARE
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OXFORD CIRCUS
SOUTH EALING
NORTHFIELDS
BOSTON MANOR
OSTERLEY
HOUNSLOW EAST
HOUNSLOW CENTRAL
HOUNSLOW WEST
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ACTON TOWN
SOUTH ACTON
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STAMFORD BROOK
HAMMERSMITH
BARONS COURT
ADDISON ROAD
EARLS COURT
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BROMPTON ROAD
HYDE PARK CORNER
PICCADILLY
DOVER STREET
GUNNERSBURY
KEW GARDENS
RICHMOND
TURNHAM GREEN
RAVENSCOURT PARK
WEST KENSINGTON
WEST BROMPTON
SOUTH KENSINGTON
SLOANE SQUARE
ST. JAMES PARK
WALHAM GREEN
PARSONS GREEN
PUTNEY BRIDGE
EAST PUTNEY
SOUTHFIELDS
WIMBLEDON PARK
WIMBLEDON
REFERENCE
DISTRICT RAILWAY
BAKERLOO LINE
PICCADILLY LINE
EDGWARE, HIGHGATE & MORDEN LINE
CENTRAL LONDON RLY
METROPOLITAN RLY.
METROPOLITAN RLY. (GREAT NORTHERN & CITY SECTION)
EAST LONDON RAILWAY
INTERCHANGE STATIONS
UNDER CONSTRUCTION
UNDERGROUND
H.C. BECK

Generalization Example

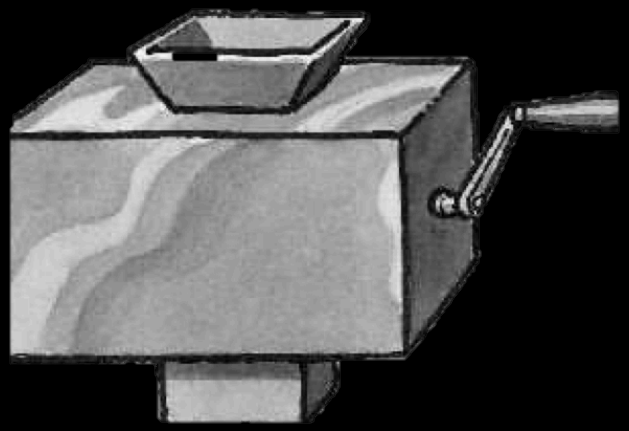
- You have a farm with many kinds of animals
- Different food for each
- You have directions that say
  - To feed dog, put dog food in dog dish
  - To feed chicken, put chicken food in chicken dish
  - To feed rabbit, put rabbit food in rabbit dish
  - Etc…
- How could you do better?
  - To feed <animal>, put <animal> food in <animal> dish

Generalization (in CS10)

- You are going to learn to write functions, like in math class:

$$y = \sin(x)$$

- You should think about **what inputs make sense to use so you don't have to duplicate code**



"Function machine" from *Simply Scheme* (Harvey)

Summary

- Abstraction is one of the big ideas of computing and computational thinking

- Think about driving. How many of you know how a car works? How many can drive a car? Abstraction!

Anyone who knows how to drive can operate a hybrid, an electric car, or a diesel car, because they've kept the same Abstraction!
(right pedal faster, left pedal slower)