

# Team Project Specification (17%)

## CPSC 3110 Simulation

Instructor: Kyungjae Lee  
(call me *KJ*)

**Next week:**  
**5 minute proposal presentation**

- Your team proposal (around 3 pages + ) includes (1) overall summary of the project (2) UI sketch (3) investigation/research with reference image and links.

# Team Project Goal

Research + Development + Analysis + (Bonus mark: 1%)

In addition to all the requirement from personal project, your team must incorporate two components:

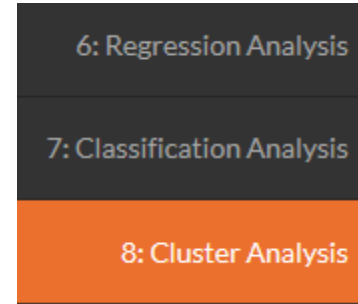
1. Graphic User Interface requirement

- Must have minimum 5 user Interface Components.
- Each UI component must control various movements (or states) of your objects (including environment factors/force).
- Each UI component must be different types (Button, Scrollbar, Handles, etc.)
- At least 2 UI components must be your own custom creation using primitive shapes (e.g., rectangle, circle etc) in addition to using build-in Processing examples.

2. One of following algorithm techniques

- Autonomous Agents
- Cellular Automata
- Finite State Machine
  - Unity Game Engine example
  - Finite-State Machines: Theory and Implementation
  - State: Game Programming Patterns

1. Analysis technique (from Java textbook)



2. Data visualization tool

- Tableau software

ACM Conference paper submission

Previous requirement

# Project Goal:

## Research + Development + Analysis

### I. Research

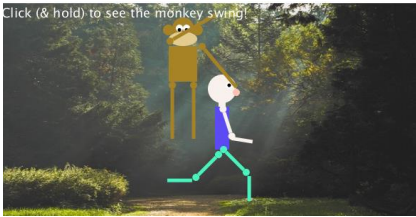
- Investigate certain phenomena showing random walk covered in [Chapter Introduction](#) of *Nature of Code* (e.g., natural phenomena ([link 1](#), [link 2](#)), [financial market](#), [human behavior](#), [robot mobility](#), [animal behavior](#), [crowd movements in city](#), [biology](#), population growth under certain environment etc.) and define problem domain (category, market sector, context etc.).

### II. Development ([Randomization + Stack-based hierarchical objects](#))

- Based on techniques covered this semester, model/construct your problem domain (**object** + **environment**) and simulate its change/evolution across time using Processing.
  - a) A couple of **main objects** navigating/exploring problem domain/environment(s)
    - For each object, design user interaction to simulate a few different randomization techniques including your two custom random functions. You must explain your rationale for the design of your custom random functions. Also, you must include built-in Processing random methods [randomGaussian\(\)](#), [noise\(\)](#), [random\(\)](#)
  - b) **A few objects (or environments)** affecting/triggering diverse movements of the main object. On your project report (3/01), please describe each environmental (or neighboring) factors providing different influences.
  - c) For object construction, review the following slides (Stack-based (push-pop matrix) object construction showing inheritance (multiple class design showing parent-child relationship)

### III. Analysis

- Record data of your simulation and generate statistical visual analysis (called visual analytics, information visualization, or scientific visualization), and generate separate txt (or csv) files showing different randomization movements. Based on lab 4 (Java file exercises), design both an analysis program showing filtering, sorting, merging, and minimum one graph showing the visualization of your data (e.g., scatter plot, normal distribution). Review Processing commands relate to file I/O.
  - [createWriter\(\)](#), [saveStrings\(\)](#), [Data handling tutorial](#)



# General guideline for Object modeling

## Stack-based Push-Pop 2D Transformation Matrix

- I. Your objects must include following mechanism.
  1. Use of Java's Generic (a) [ArrayList](#) for a [graphics application](#) as well as an (b) [an array](#).
  2. Design (c) [class files](#) to build (d) [multiple parent-child hierarchical objects](#).
    - For your project, you need to create minimum three hierarchical/inheritance objects (one should look like a human figure, the another two could be an animal, alien creature, or natural object, building, or environment (e.g., car, tree with leaves) with hierarchy).
  3. Design/apply (e) [push and pop](#) stack structure to properly associate hierarchical objects to build gestures for [2D transformation](#).
  4. Design a custom (f) [function/method blocks](#) to add a unique movement of your parent-child based objects.
  5. Add both (g) [mouse interaction](#) and (h) [keyboard interactions](#) to transform hierarchy chained objects (e.g., rotating hierarchical objects) expressing different [motion](#).
  6. You must incorporate some (h) randomness; [random\(\)](#), [noise\(\)](#) (Ex [1](#), [2](#), [3](#))
  7. Document your [unique design approach/process](#) and (i) [research endeavor](#).



# Three things to do in this course !!!

1. Lab Exercises

2. Individual Project

3. Team project



Regard your team as a professional production house/company!

Project management!

- Appoint a project manager!
- Divide workload through your departments (animation crews, compositing crews etc.)



# Team Dynamics:

<http://supercell.com/en/our-story/>



<https://youtu.be/PEscqghqb8U>

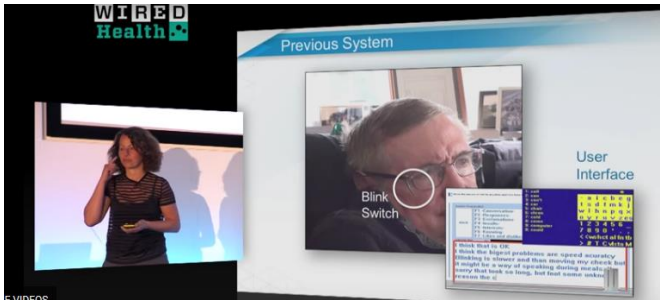
- The Supercell Story: Starting at 5:16



# Did your team finalize your project concept?

Explore diverse applications

- Prototyping and testing Assistive Technology ([Example from Intel](#))



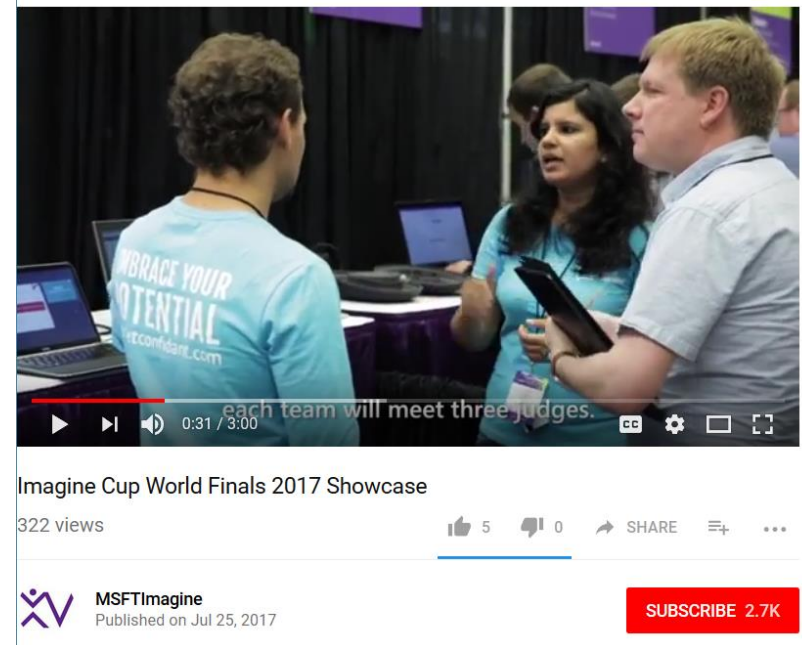
## Users with Disabilities

- Designers must plan early to accommodate users with disabilities
- Early planning is more cost efficient than adding on later
- Businesses must comply with the "[Americans With Disabilities Act](#)" for some applications
- Growing world-wide support, for example:
  - European Union Mandate 376 will require procurement and development of accessible technologies by EU governments (<http://www.mandate376.eu/>)
  - United Nations Convention on the Rights of Persons with Disabilities (CRPD), an international human rights agreement (<http://www.un.org/disabilities/convention/conventionfull.shtml>)



# Any team focusing on prototyping/testing automation User Interface/Interaction Design?

- Review current innovations
- Review foundations of UX/UI design



# Choose an interaction style

- Direct manipulation
- Menu selection
- Form fill-in
- Command language
- Natural language

**Google Assistant vs Siri vs Bixby vs Amazon Alexa vs Cortana – Best virtual assistant showdown!**

**How to Kill Active Listening on Siri, Cortana, Alexa, and Google**

Advantages	Disadvantages
<b>Direct manipulation</b> Visually presents task concepts Allows easy learning  Allows easy retention Allows errors to be avoided Encourages exploration Affords high subjective satisfaction	May be hard to program May require graphics display and pointing devices
<b>Menu selection</b> Shortens learning Reduces keystrokes Structures decision making Permits use of dialog-management tools Allows easy support of error handling	Presents danger of many menus May slow frequent users Consumes screen space Requires rapid display rate
<b>Form fill-in</b> Simplifies data entry Requires modest training Gives convenient assistance Permits use of form-management tools	Consumes screen space
<b>Command language</b> Flexible Appeals to “power” users  Supports user initiative Allows convenient creation of user-defined macros	Poor error handling Requires substantial training and memorization
<b>Natural language</b> Relieves burden of learning syntax	Requires clarification dialog May not show context May require more keystrokes Unpredictable

# Spectrum of directness

An example of progression towards more direct manipulation: less recall/more recognition, fewer keystrokes/fewer clicks, less capability to make errors, and more visible context.

>MONTH/08;DAY/21

a. Command line

MM/DD 08/21

b. Form fill-in to reduce typing

MM 08 DD 21

c. Improved form fill-in to clarify and reduce errors

Month 

JAN
FEB
MAR
APR
MAY
JUN
JUL
<b>AUG</b>
SEP
OCT
NOV
DEC

 Day 

21
----

d. Pull-down menus offer meaningful names and eliminate invalid values

August						
S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
<b>21</b>	22	23	24	25	26	27
28	29	30	31			

e. 2-D menus to provide context, show valid dates, and enable rapid single selection

# The 8 Golden Rules of Interface Design

1. Strive for consistency
  2. Cater to universal usability
  3. Offer informative feedback
  4. Design dialogs to yield closure
  5. Prevent errors
  6. Permit easy reversal of actions
  7. Keep users in control
  8. Reduce short-term memory load
- Prevent errors:
    - Make error messages specific, positive in tone, and constructive

# Automation and human control

- Successful integration:
  - Users can avoid:
    - Routine, tedious, and error prone tasks
  - Users can concentrate on:
    - Making critical decisions, coping with unexpected situations, and planning future actions

# Automation and human control

## Humans Generally Better

- Sense-making from hearing, sight, touch, etc.
- Detect familiar signals in noisy background
- Draw on experience and adapt to situations
- Select alternatives if original approach fails
- Act in unanticipated situations
- Apply principles to solve varied problems
- Make subjective value-based judgments
- Develop new solutions
- Use information from external environment
- Request help from other humans

## Machines Generally Better

- Sense stimuli outside human's range
- Rapid consistent response for expected events
- Retrieve detailed information accurately
- Process data with anticipated patterns
- Perform repetitive actions reliably
- Perform several activities simultaneously
- Maintain performance over time



# Automation

McDonald's hits all-time high as Wall Street cheers replacement of cashiers with kiosks

**McDonalds Is Replacing 2,500 Human Cashiers With Digital Kiosks: Here Is Its Math**

**McDonald's shoots down fears it is planning to replace cashiers with kiosks**

Amazon Go And McDonald's Kiosks Will Make Minimum Wage Irrelevant

**McDonald's fast-food ordering kiosks will boost sales, analyst says**



*McDonald's restaurant employees rally after walking off the job to demand a \$15 per hour wage and union rights during nationwide 'Fight for \$15 Day of Disruption' protests on November 29, 2016 in Los Angeles, California. (David McNew/Getty Images)*





# Automation and human control

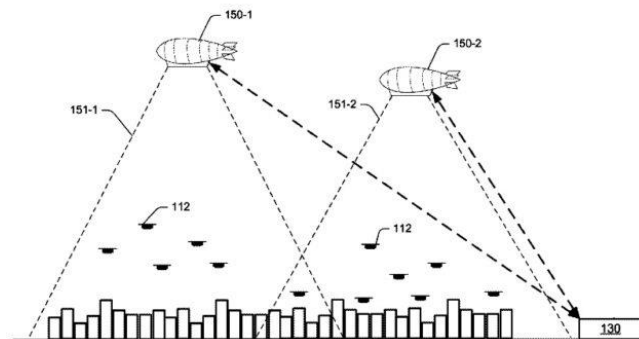
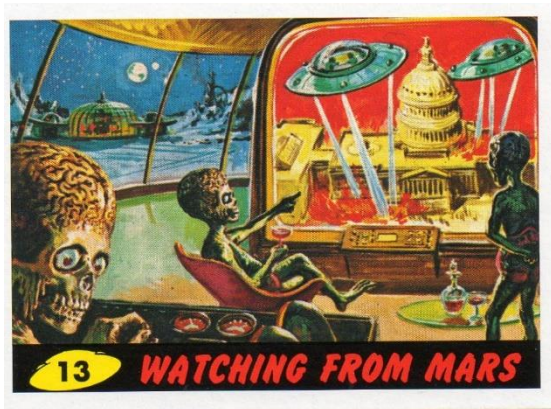
- Goals for autonomous agents
  - Knows user's likes and dislikes
  - Makes proper inferences
  - Responds to novel situations
  - Performs competently with little guidance
- Tool-like interfaces versus autonomous agents



- [Robotic Tortoise Helps Kids to Learn That Robot Abuse Is a Bad Thing](#)

# How about testing of User Interface for Drone?

- [How Amazon Will Keep Drone Delivered Packages Protected](#)
- [Protect your Amazon drone-delivered package? There's an APP airbag for that.](#)
- [Battle of the retail blimps: Amazon and Walmart propose airship drone stations](#)



U.S. Patent Mar. 13, 2018 Sheet 1 of 11 US 9,914,539 B1

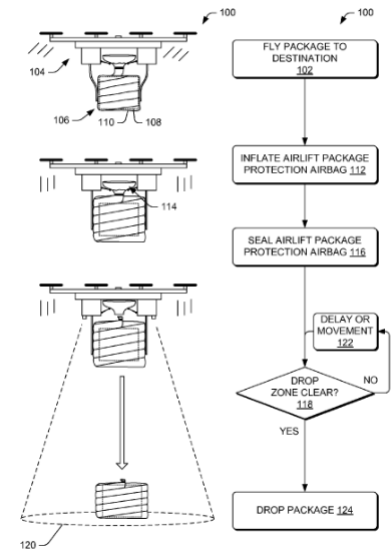
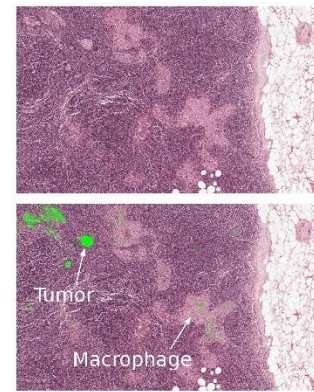
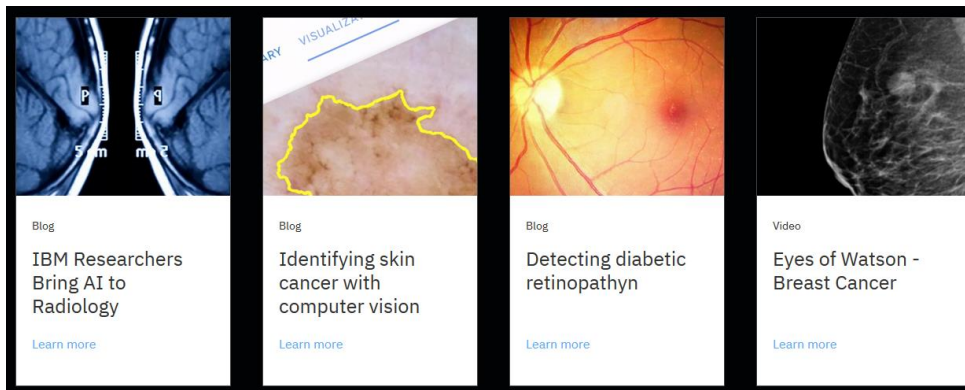
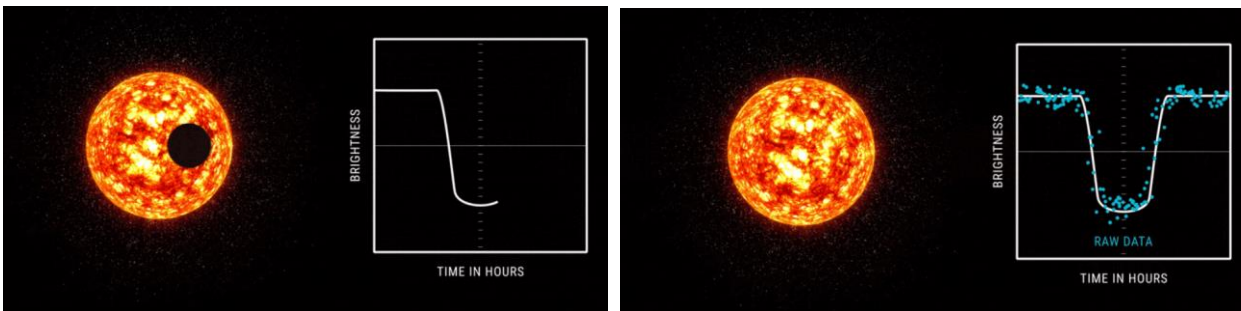


FIG. 1

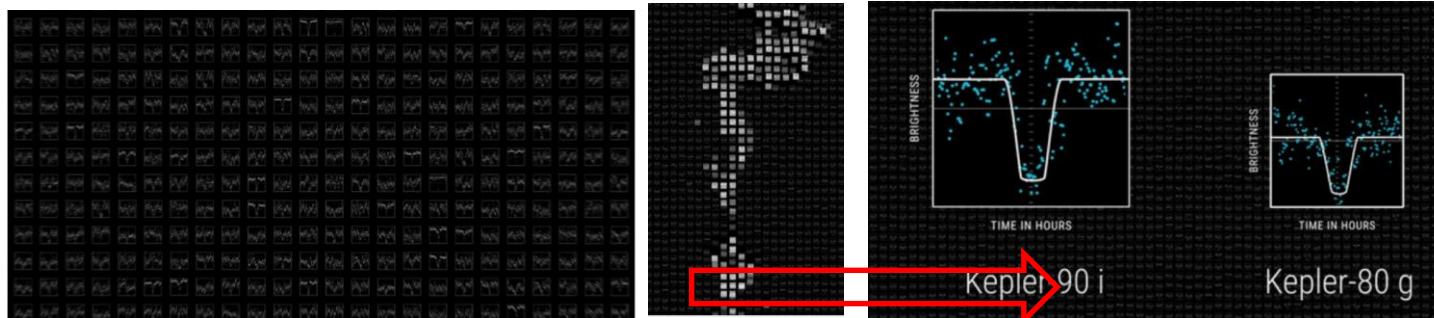


# Design/testing of Image Processing application

- Earth to exoplanet: Hunting for planets with machine learning



The measured brightness of a star decreases ever so slightly when an orbiting planet blocks some of the light. The Kepler space telescope observed the brightness of 200,000 stars for 4 years to hunt for these characteristic signals caused by transiting planets.



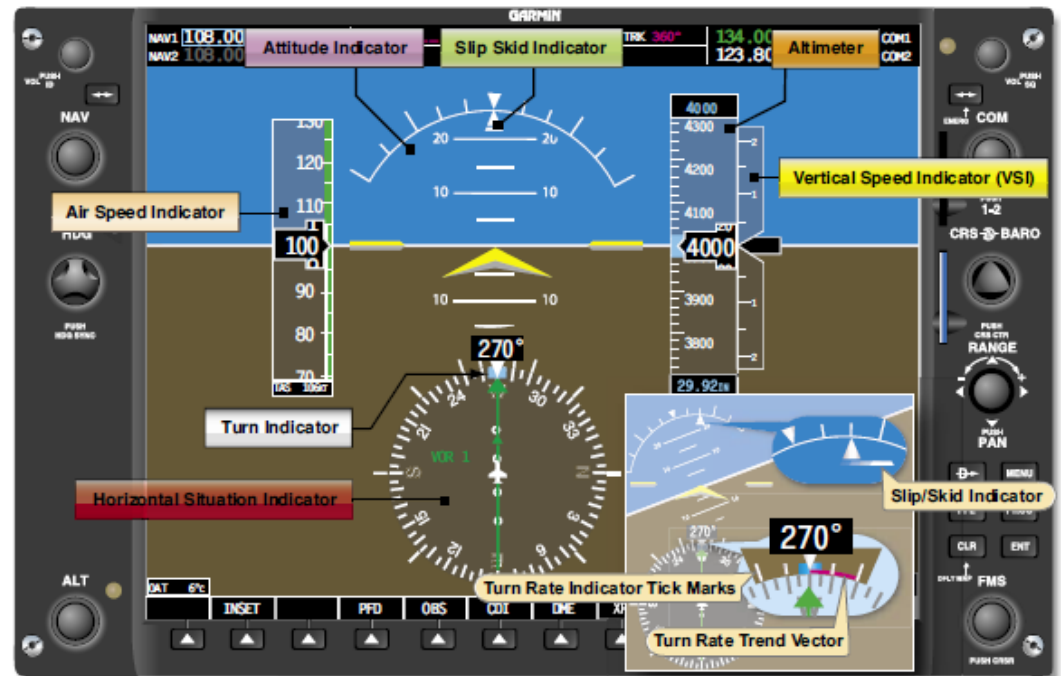
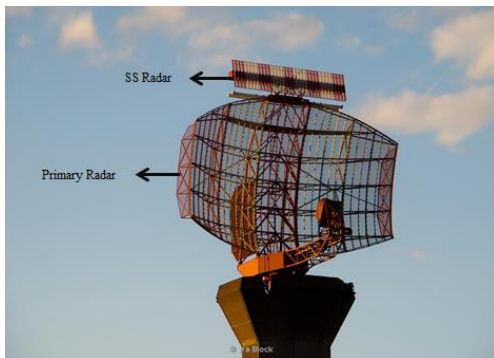
Google used 15,000 labeled Kepler signals to train our machine learning model to identify planet signals. We used this model to hunt for new planets in data from 670 stars, and discovered two planets missed in previous searches.

# Design/testing of Pilot Cockpit Interface?

- Modern Electronic Flight Display (EFD)

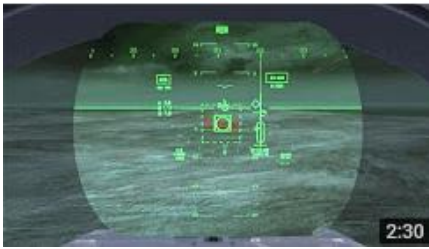
Air Traffic Control

<https://www.flightradar24.com/>



<https://youtu.be/bJNyZiHVBAA> Modern EFIS Display

<https://youtu.be/5YoBtiuWCAI> EFIS showing an autopilot coupled approach



# Pilot Cockpit Interface

- Vintage Commercial Cockpit (note all of the knobs and dials)
- F-35 Pilot with Rockwell Collins Gen III Helmet Mounted Display System (worlds most advanced helmet-mounted display system)
  - Provides enhanced situational awareness
  - Integrated, virtual heads-up display on the helmet visor and mission information
  - Night vision capable
  - Lightweight, with optimized centre of gravity to minimize pilot fatigue
  - Provides target verification, designation, and targeting via visual input
  - Look-through aircraft capability (6 external cameras)

<https://youtu.be/Ay6g66FbkmQ> Pilot's Eye View of F-35 Head-Up Display

# Pilot Cockpit Interface

- Why is this important?



- Aircraft safety is of great importance
- Overall trend has been a reduction of incidents, accidents and crashes.

<https://youtu.be/bMUdXJPWm8>

Cross wind landing attempt ( you only need the first 30 sec's)

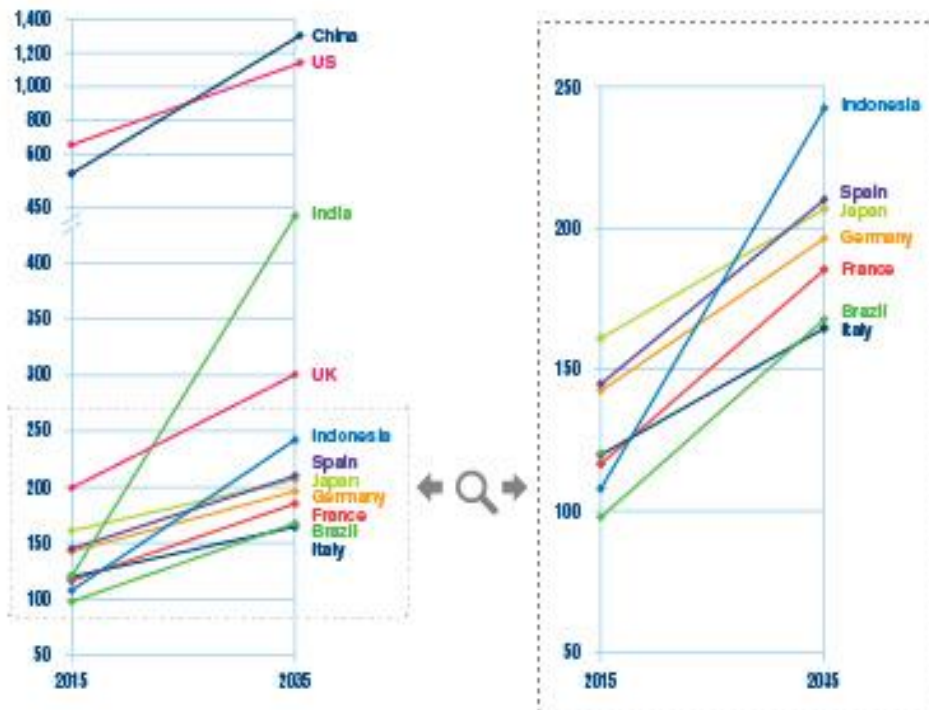


# Future Air Navigation

- Reasons why?

## Top Ten Passenger Markets

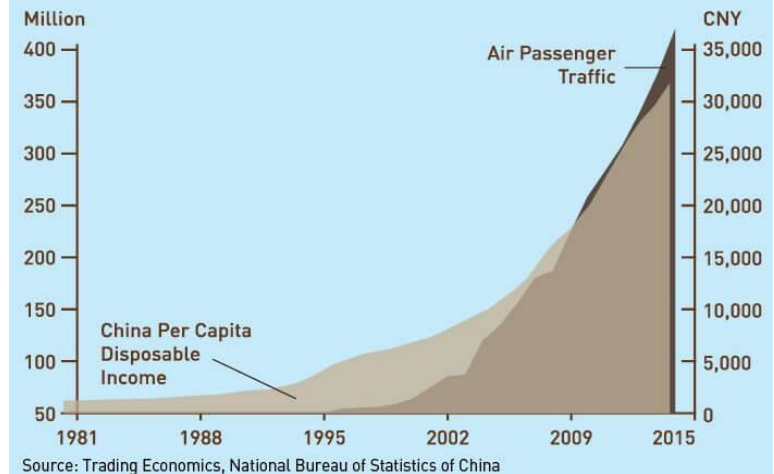
Million O-D passenger journeys (to, from and within)



\* Markets are being developed

## Consumer Story

Growth in China's air traffic has paralleled income growth





# Future Air Navigation

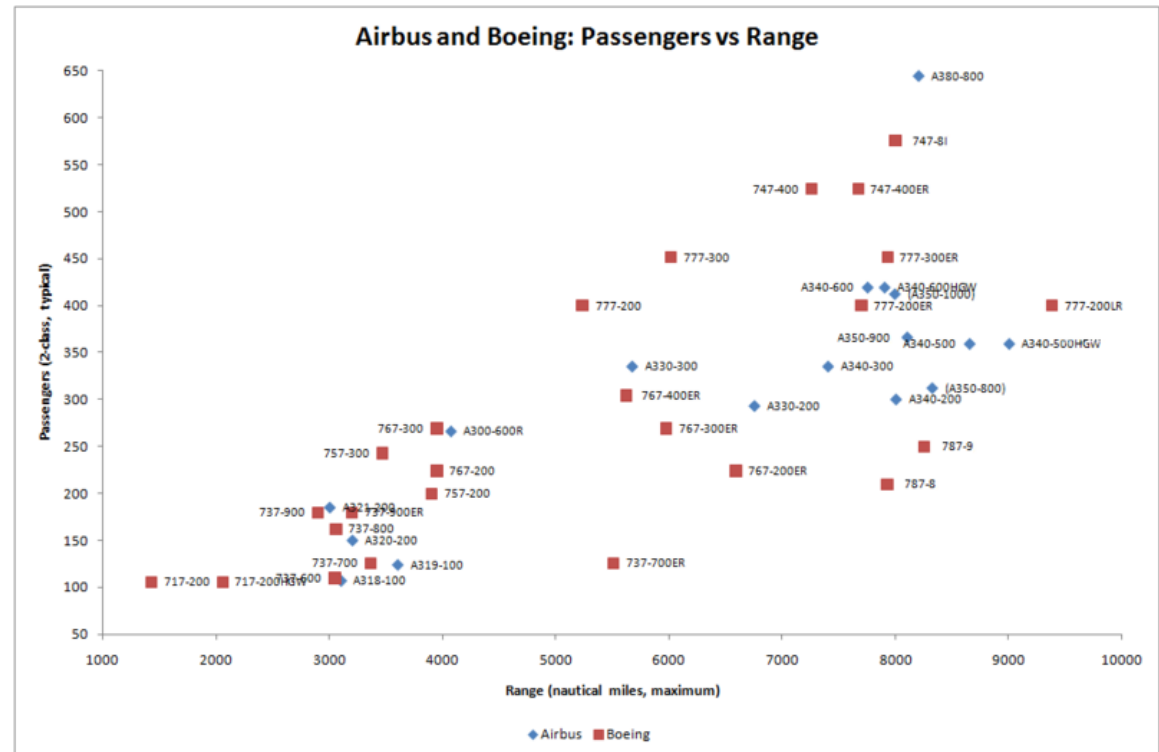


- Reasons why?
  - Aircraft are growing in size and increasing in range

<https://www.youtube.com/watch?v=B7LcKhZZLSY>

Aircraft size comparison

Passenger		
	3-Class No. of Seats	Range nmi (km)
747-8	467	8,000 (14,810)
777-300ER	365	7,830 (14,485)
777-200LR	301	9,395 (17,395)
777-200ER	301	7,725 (14,305)
787-9	250-290	8,000-8,500 (14,810-15,740)
787-8	210-250	7,650-8,350 (14,160-15,480)
2-Class		
737-900ER	180	3,265 (6,045)
737-800	162	3,115 (5,765)
737-700ER	149*	5,775 (10,695) *All business class
737-700	126	3,440 (6,370)
737-600	110	3,255 (6,010)





# Future Air Navigation

- Why is this important?

- Air travel is increasing by +5.8% annually
- Aircraft safety is of great importance

<https://www.youtube.com/watch?v=CpY71stVOh4>

40 min's at Boston International

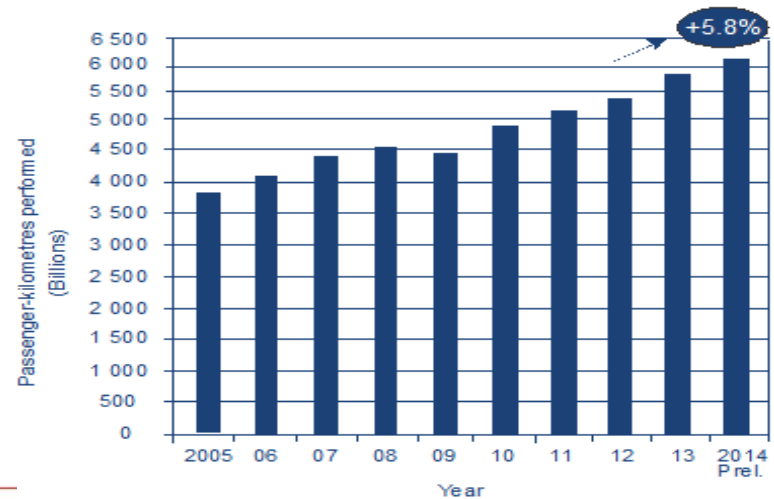


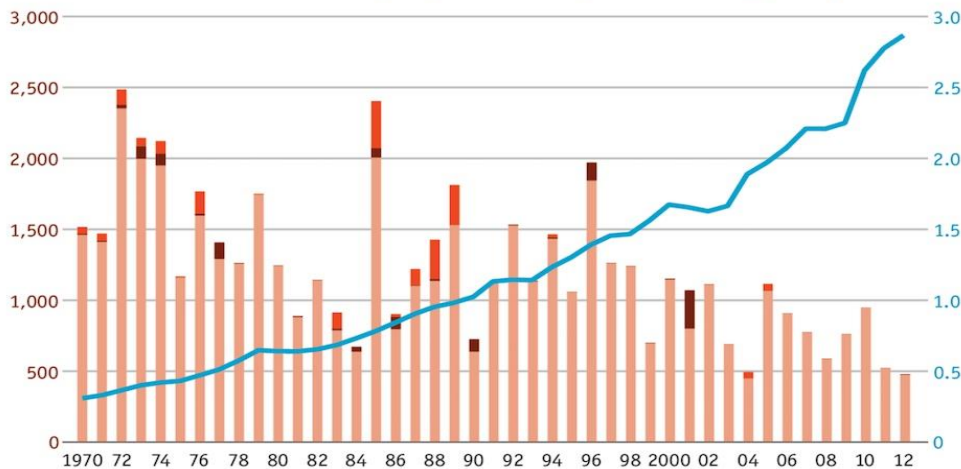
Figure 1. Total scheduled traffic (revenue passenger-kilometres performed, 2005-2014)

## Aircraft safety

Worldwide

Casualties\* due to: accident hijacking bombing

Aircraft passengers carried, bn



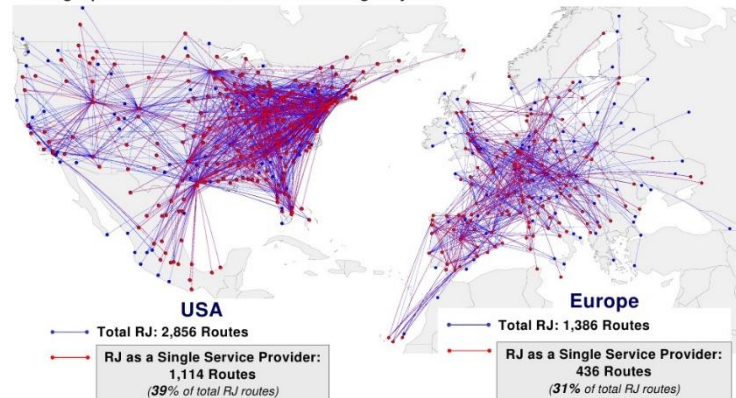
Sources: World Bank; Aviation Safety Network

\*Excluding ground casualties

## 50-seat Regional Jet Operation - 2006



Single provider routes can benefit from higher yields

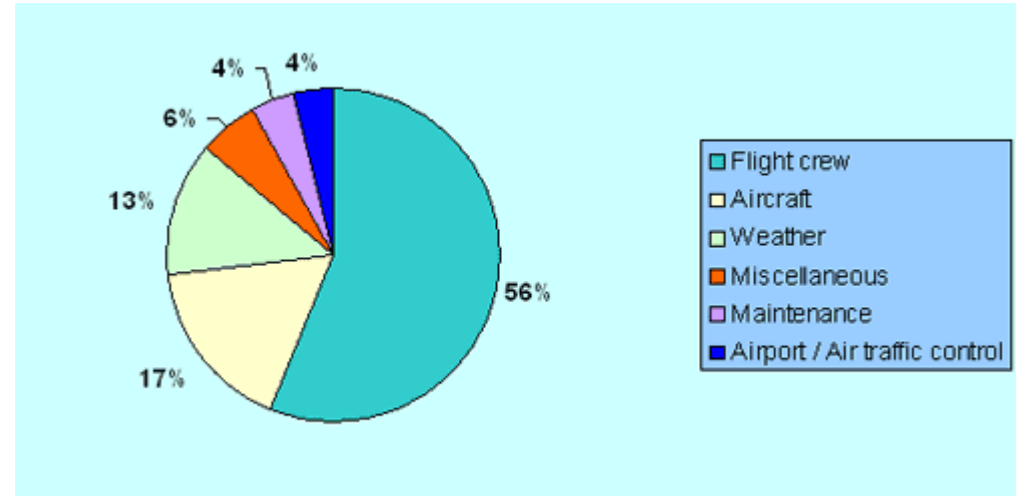


Source: Back (Jan 07: EJU135/140/145, CPU100/200/440, 328 Jet; more than one flight per week)

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# Pilot Cockpit Interface

- Leading cause?

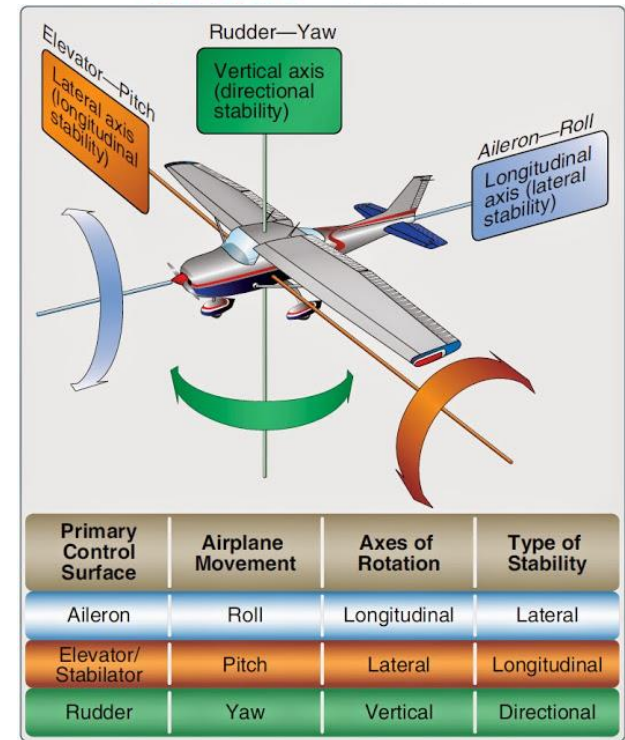
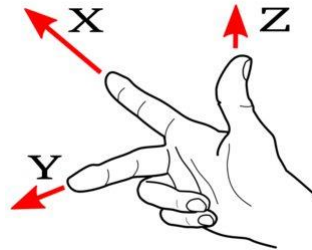


- Overwhelmingly human error <https://youtu.be/DWPIlvjnNhU> Pilot Errors
- What is Safety?
  - Freedom from the occurrence of risk of injury, danger, or loss
- What is a Hazard?
  - Something causing unavoidable danger, peril, risk, or difficulty
- What is Risk?
  - The combination of the frequency (probability) of an occurrence and its associated level of severity

What could be testing scenarios?

# Pilot Cockpit Interface

- Aircraft Principle Axes
  - Aircraft is free to move in 3 directions
  - Aircraft is free to rotate in 3 axes
  - Right Hand Rule



Primary Control Surface	Airplane Movement	Axes of Rotation	Type of Stability
Aileron	Roll	Longitudinal	Lateral
Elevator/Stabilator	Pitch	Lateral	Longitudinal
Rudder	Yaw	Vertical	Directional

- On aircraft these are intentionally produced by means of moving control surfaces
- Movement of one usually disturbs the others

<https://youtu.be/wn2wvsKlIMo>

Aircraft axis (rotation X, Y and Z)

# Pilot Cockpit Interface

- Attitude representation of the Attitude Indicator (relation of the aircraft to the real horizon)

Redbull Air Racer

<https://youtu.be/V3wol8FCr9w>

EFIS Autopilot Synthetic Approach

[https://youtu.be/icm44\\_YQeFI](https://youtu.be/icm44_YQeFI)

Synthetic Vision

<https://youtu.be/H8SID85-BQk>

Head-Up Display

<https://youtu.be/0ISvrO3j9SU>

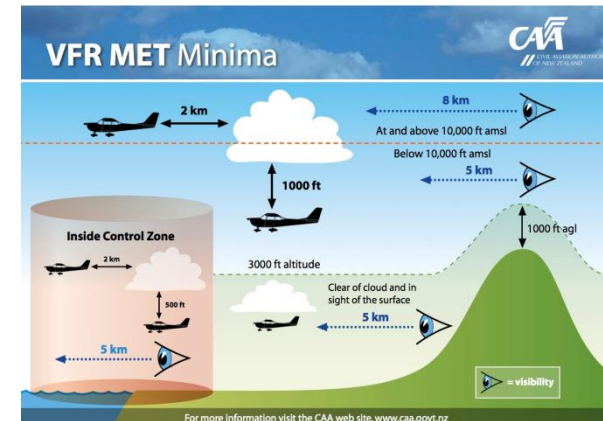
Rockwell Collins Head-up Vision system

<https://youtu.be/R6kKdww6ss0>



# Pilot Cockpit Interface

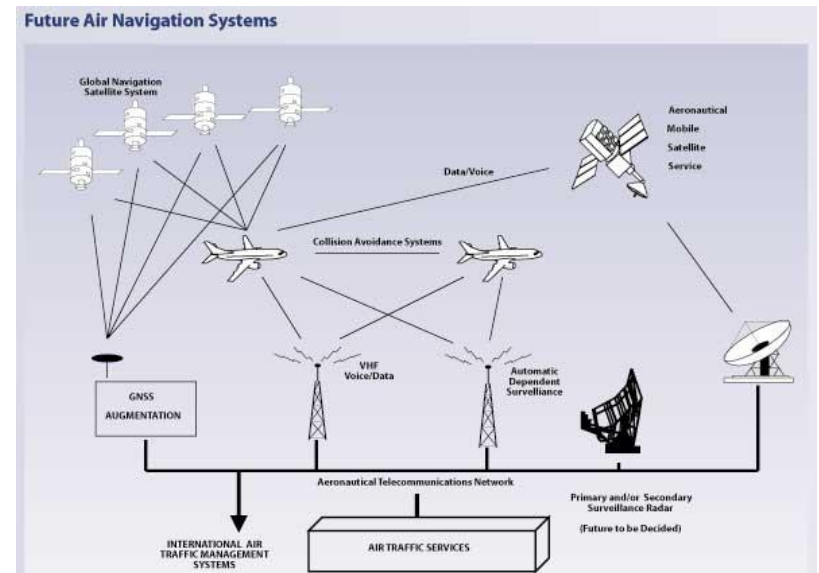
- **Flight Conditions** (Visual Meteorological Conditions (VMC))
  - VFR (Visual Flight Rules)
    - fly a plane solely by reference to outside visual cues, such as the horizon to maintain orientation, nearby buildings and terrain features for navigation, and other aircraft to maintain separation
  - IFR (Instrument Flight Rules)
    - visual cues outside the aircraft are obscured by weather or darkness



# Future Air Navigation

- System Architecture for the Future Air Navigation
  - Avionics system which provides direct data link communication between the aircraft and the ground based air traffic controller (ATC) Provides enhanced situational awareness

[https://www.youtube.com/watch?v=FU\\_pY2sTwTA](https://www.youtube.com/watch?v=FU_pY2sTwTA) GPS





# Pilot Cockpit Interface

- Navigation [https://youtu.be/2uf5p\\_VO4WA](https://youtu.be/2uf5p_VO4WA) Boeing 747-400 Navigation Display
  - Air navigation is the process of piloting an aircraft from one geographic position to another
  - Aeronautical Charts
    - Road map for a pilot flying under VFR flight conditions

