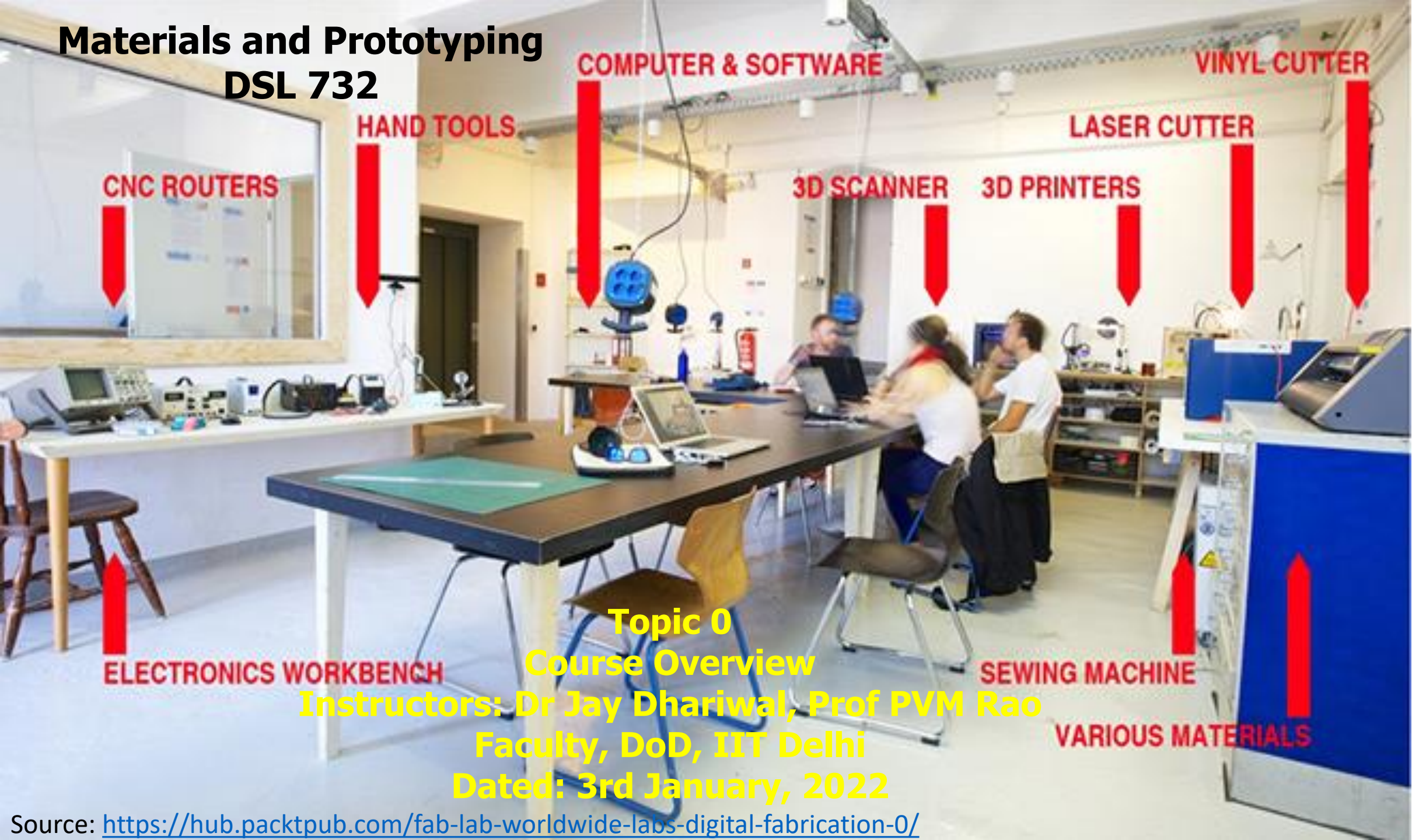


Materials and Prototyping DSL 732



CNC ROUTERS

HAND TOOLS

COMPUTER & SOFTWARE

VINYL CUTTER

LASER CUTTER

3D SCANNER

3D PRINTERS

ELECTRONICS WORKBENCH

SEWING MACHINE

VARIOUS MATERIALS

Topic 0

Course Overview

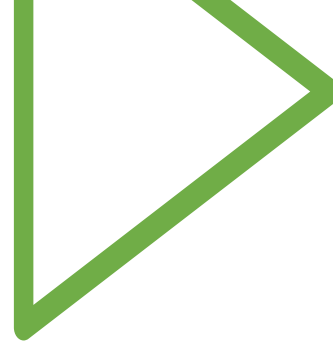
Instructors: Dr Jay Dhariwal, Prof PVM Rao

Faculty, DoD, IIT Delhi

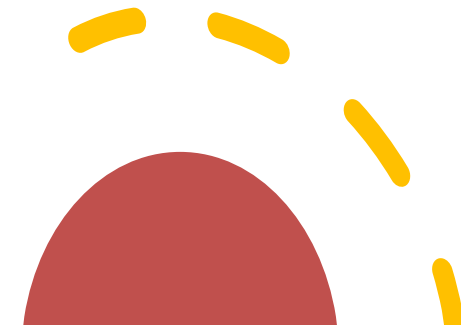
Dated: 3rd January, 2022

Introductions

- [Dr Jay Dhariwal](#)
- [Prof PVM Rao](#)
- TAs: Pooja Agarwal, Harshit Mourya
- [Yourself](#) (google form to know your expectations and skills)



Who Am I?



What was my motivation?

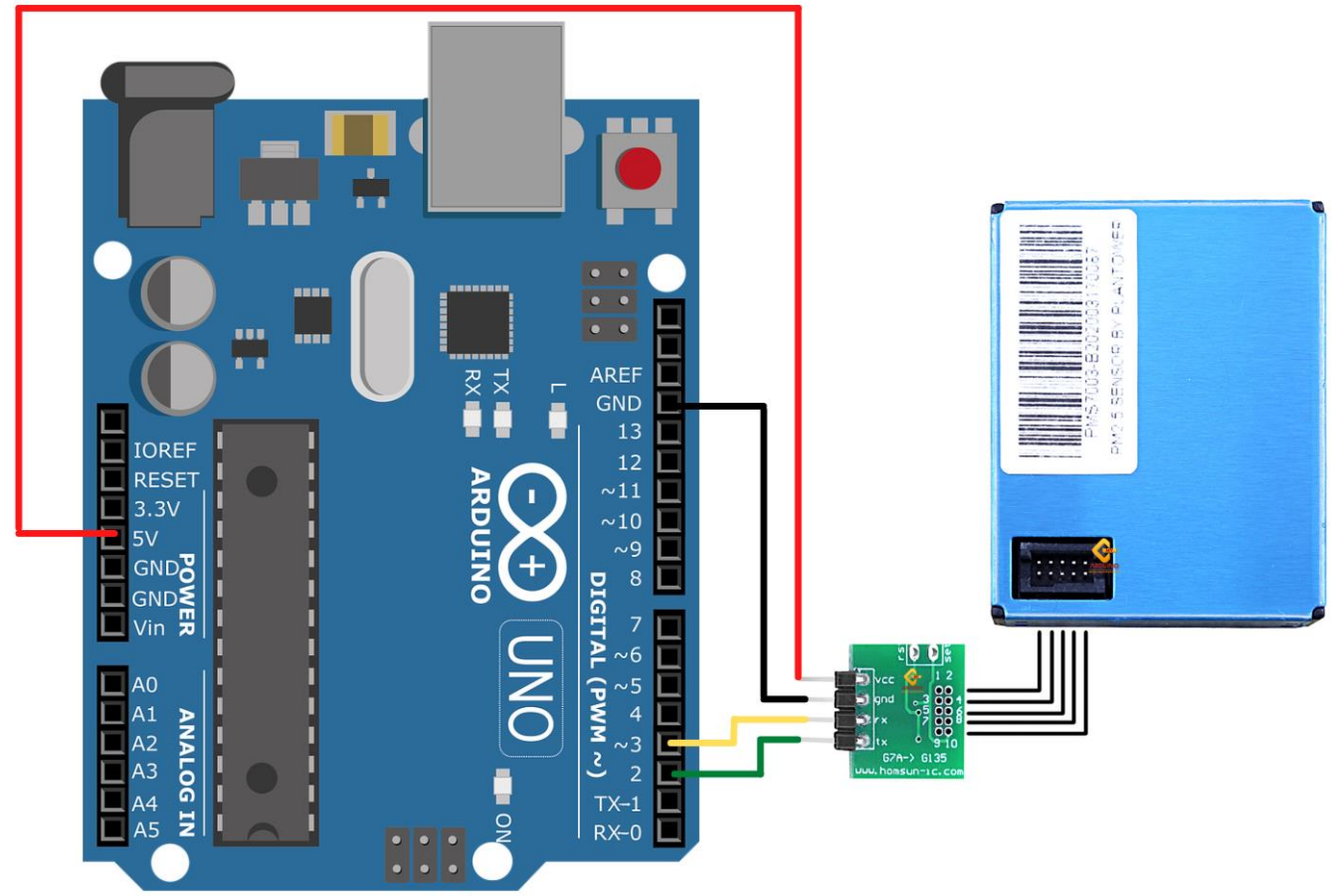
[Time Lapse Video of Team SHUNYA,
Solar Decathlon Europe 2014](#)



What is my motivation now?

Low cost sensors for IAQ monitoring

UNO	PMS7003
3.3v	3.3v
GND	GND
2	Tx
3	Rx



<https://github.com/vyomaniitd/PM2.5---PMS7003>

A breath of fresh air

How to make almost anything?

- Prof Neil Gershenfeld



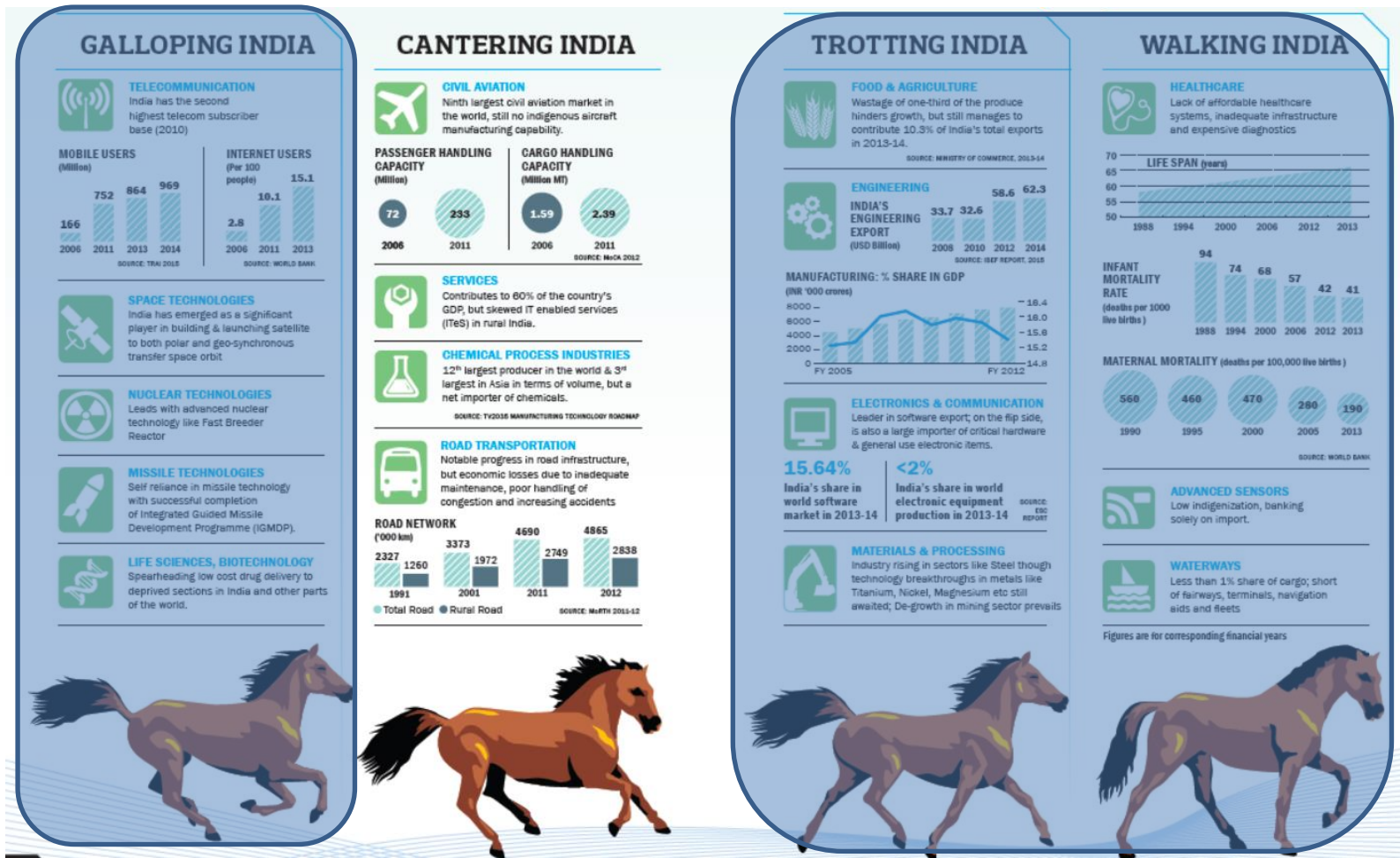
- Designers, Engineers, Architects
- Projects Screambody

Jan 16: principles and practices, presentations, introductions
Jan 23: project management
Jan 28 *recitation*: version control
Jan 30: computer-aided design
Feb 06: computer-controlled cutting
Feb 11 *recitation*: projects
Feb 13: electronics production
Feb 20: 3D scanning and printing
Feb 25 *recitation*: tools
Feb 27: electronics design
Mar 06: computer-controlled machining
Mar 11 *recitation*: design
Mar 13: embedded programming
Mar 20: molding and casting
Mar 25 *recitation*: machines
Mar 27: input devices
Apr 03: output devices
Apr 08 *recitation*: programs
Apr 10: applications and implications
Apr 17: break
Apr 24: networking and communications
Apr 29 *recitation*: economy
Apr 30: mechanical design
May 08: interface and application programming
May 13 *recitation*: education
May 15: machine design
May 22: wildcard week
May 27 *recitation*: events
May 29: invention, intellectual property, and income
Jun 06: project development
Jun 12: project presentations
Jun 14: project presentations
Jun 17: project presentations
Jun 19: project presentations

What is this course about?

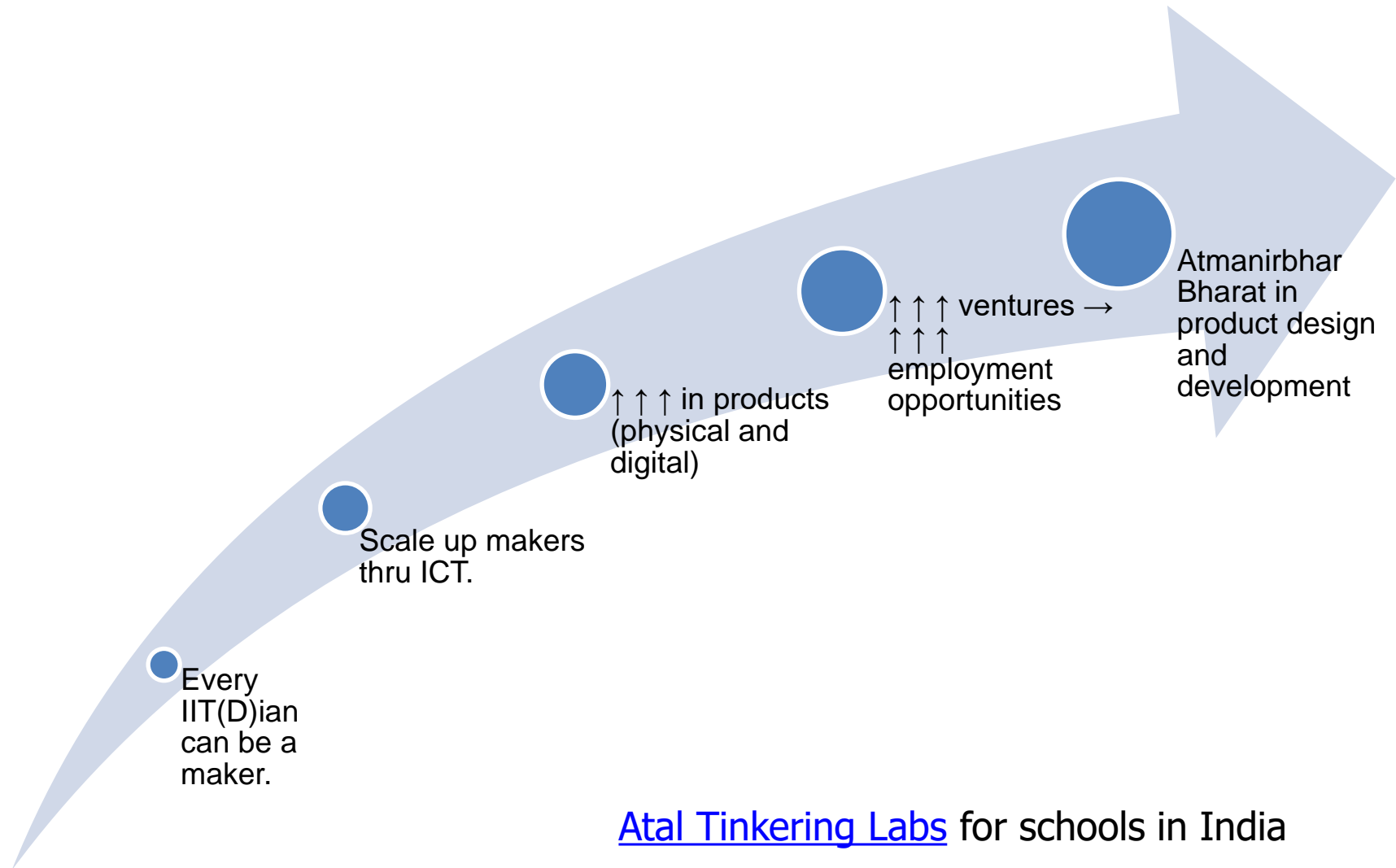
- Functional prototyping using digital fabrication techniques
- [Course website](#), curriculum and grading scheme
- [Submission format](#), moodle
- Studio based learning, hands-on experiential learning
- Peer to peer learning (helping each other, each one with different strengths)
- From “**What** to learn to make?” To “**How** to learn to make?”



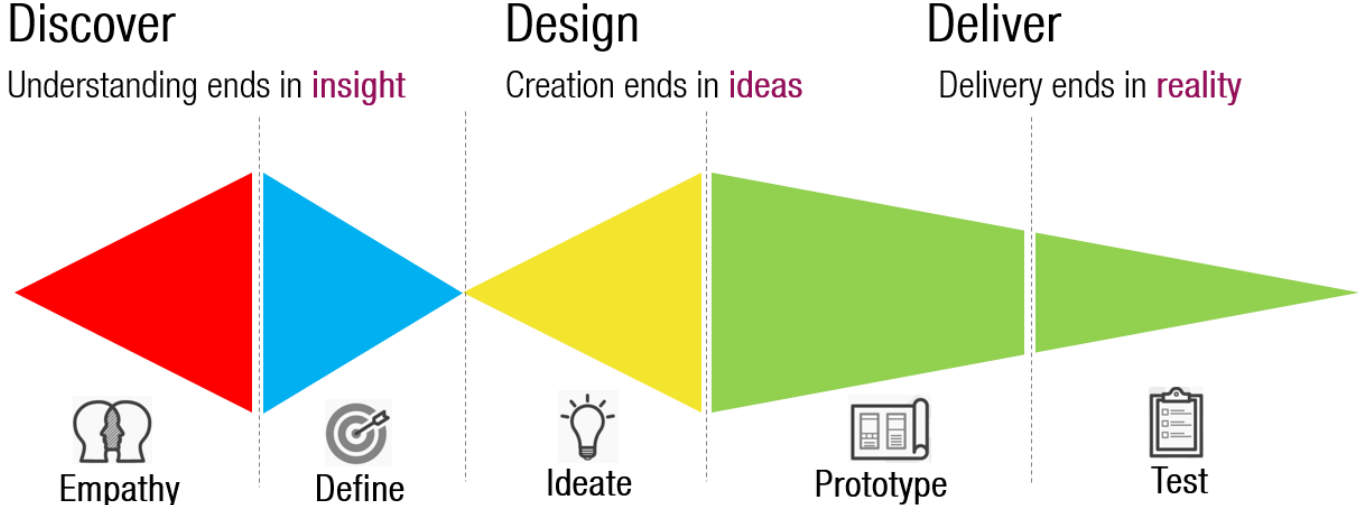


Source: Technology Vision 2035, TIFAC, Govt. of India, 2015

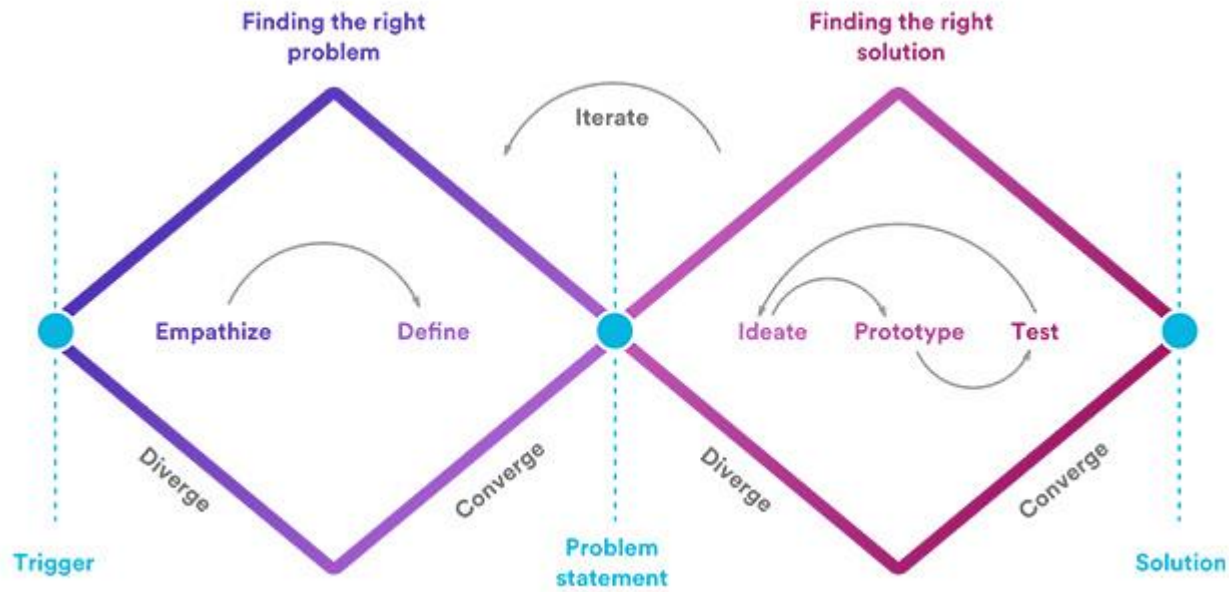
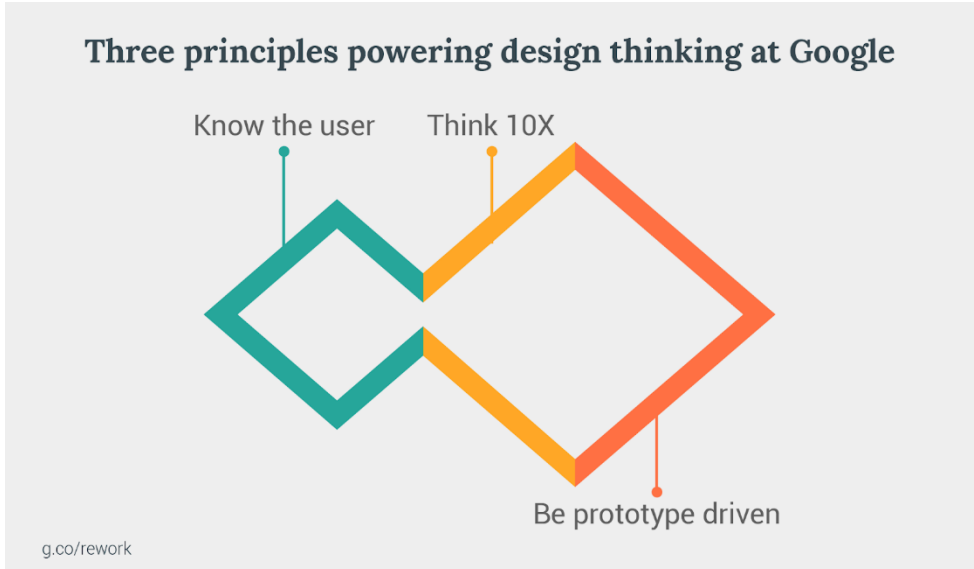
↑ ↑ ↑ indigenous design & development need of the hour



DESIGN THINKING MODEL



Design Thinking is an iterative and non-linear process in which we seek to understand the user, challenge assumptions, and redefine problems in an attempt to identify alternative strategies and solutions that might not be instantly apparent with our initial level of understanding.



Topic 1: Applications of Mechatronic Prototyping

- My Projects, Projects from Assistech Lab
- Projects from DSL 732, Autumn 2019
- [Fab Lab projects](#)
- Instructables, DIY websites
- [Sketch your project](#)
[Interactive Musical Bench](#)



Smart Cane, Assistech Lab, IIT Delhi

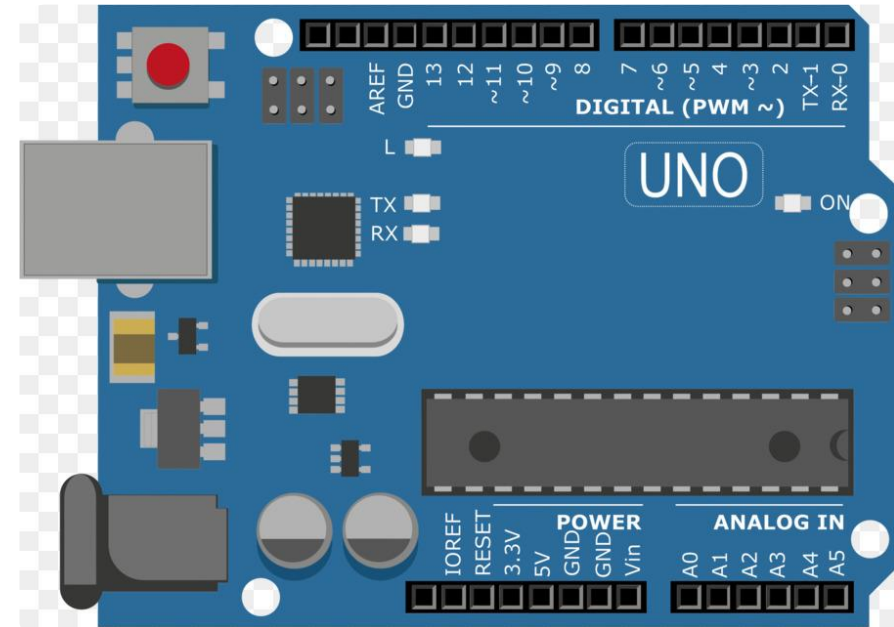
Topic 2: Website Design for Course Mgmt

- Portfolio, digital repository for others
- [html](#)
- [html, css template provided by us](#)
- [html, css template of your choice](#) [Self stabilizing box](#)
- Anything else (Javascript, Markdown, PHP)
- Image compression, Video editing.
- Project Management, Spiral Development

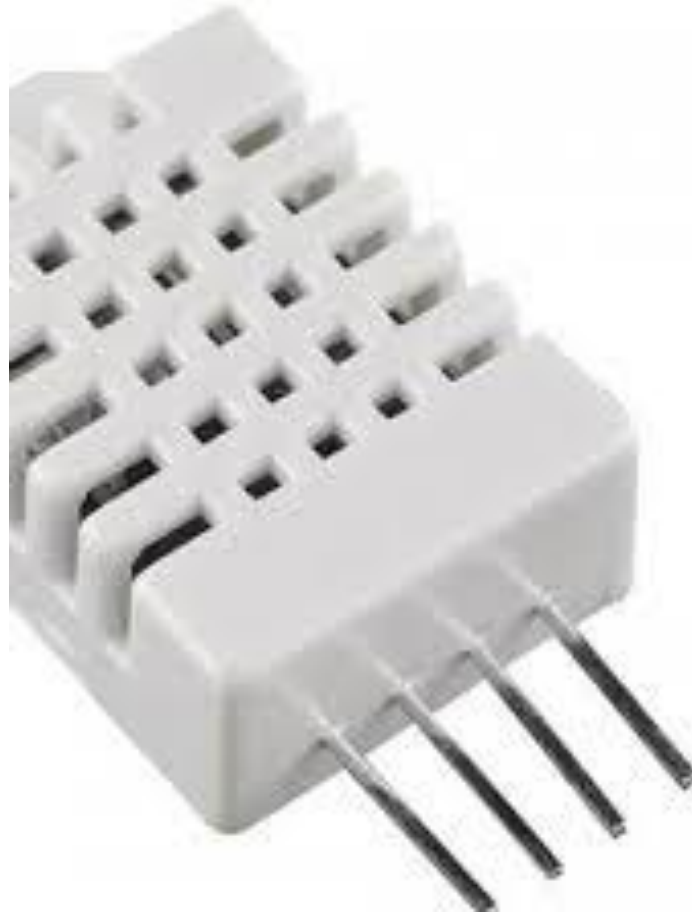


Topic 3a: μ C programming

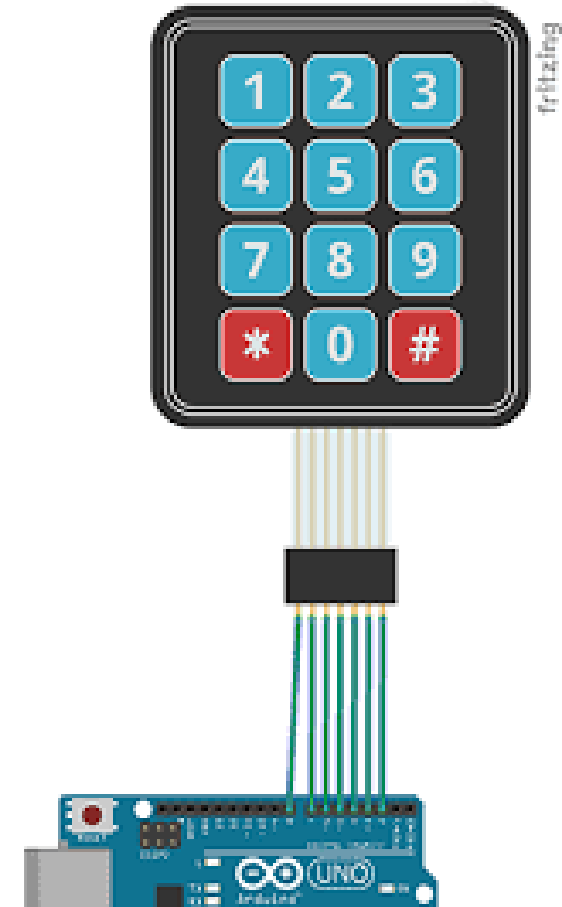
- Basics of programming, algorithm, flowcharts.
- Arduino hardware, IDE, libraries
- Arduino kit with examples
- LEDs, RGB LEDs.
- Push buttons, Buzzers.
- Electrical safety and handling
- [LED name](#)
- [Basic musical instrument](#)
- Tinkercad Simulations – [Cdr Venkat Aditya](#)



Topic 3b: Input devices

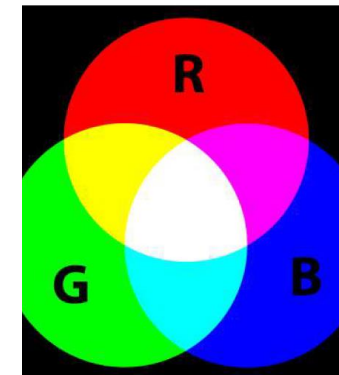
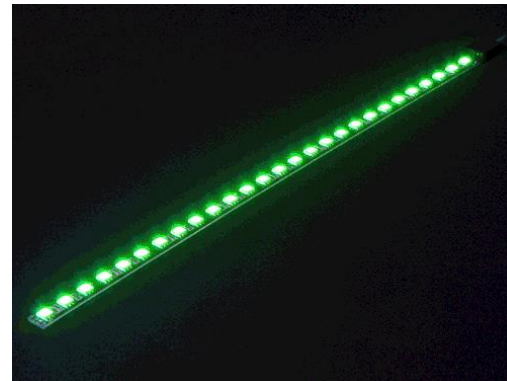
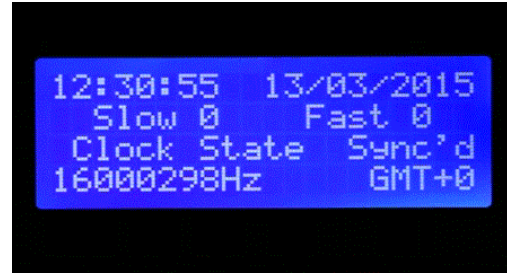


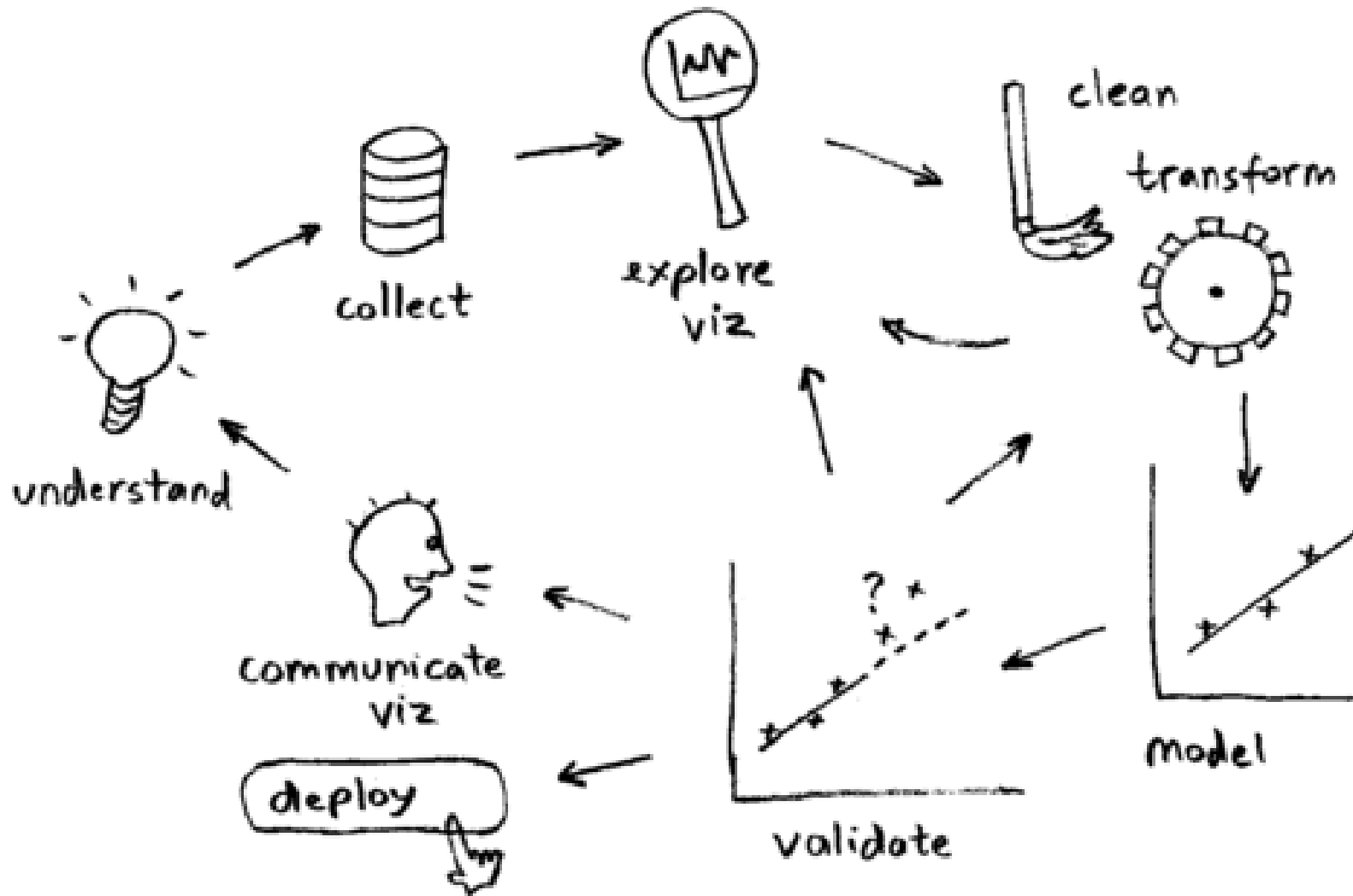
- Sensor features, datasheet
- [T+RH sensor](#), [proximity sensor](#), keypad module with uC
- Sensors in your smart phone (Talk to Me)



Output devices

- RGB LEDs, Displays, Speakers, Servo/Stepper Motors
- Ultrasonic + LED display
- Pressure sensor + speakers
- All terrain robot





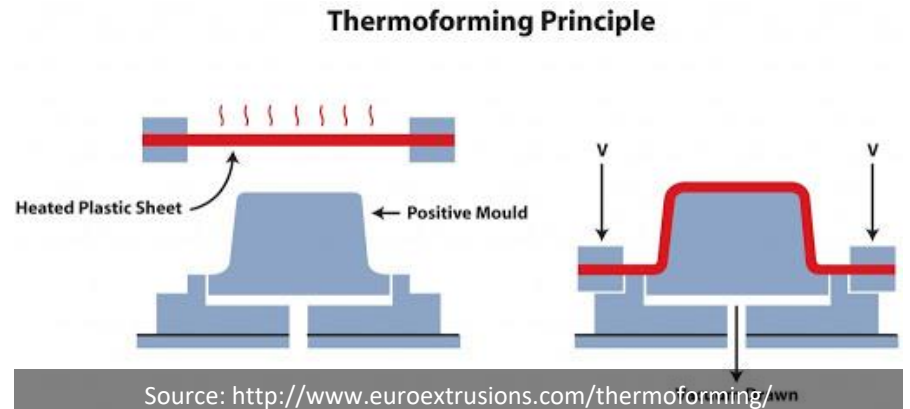
Topic 3c: Data science workflow

DSL 810: Data Driven Design <https://web.iitd.ac.in/~jay/dsl810/dsl810.html>

Source: <http://datascience.la/data-science-toolbox-survey-results-surprise-r-and-python-win/>

Topic 4: Hand and Power Tools, Thermoforming

- Manufacturing of metals, processing of plastics, thermoforming
- Makerspace access – CRF (Talk to TAs: Pooja and Harshit)
- [Makerspace training videos Atul Kumar documentation](#) (Metal and wood working)



Topic 5: 3D Printing

- Material deposition layer by layer (additive manufacturing)
- Plastic, Metal, Glass, Mortar, Carbon Fibre – 3D printing
- Different methods of 3D printing Stereolithography
- [Generative Design](#)
- [Sonsy Atul](#)

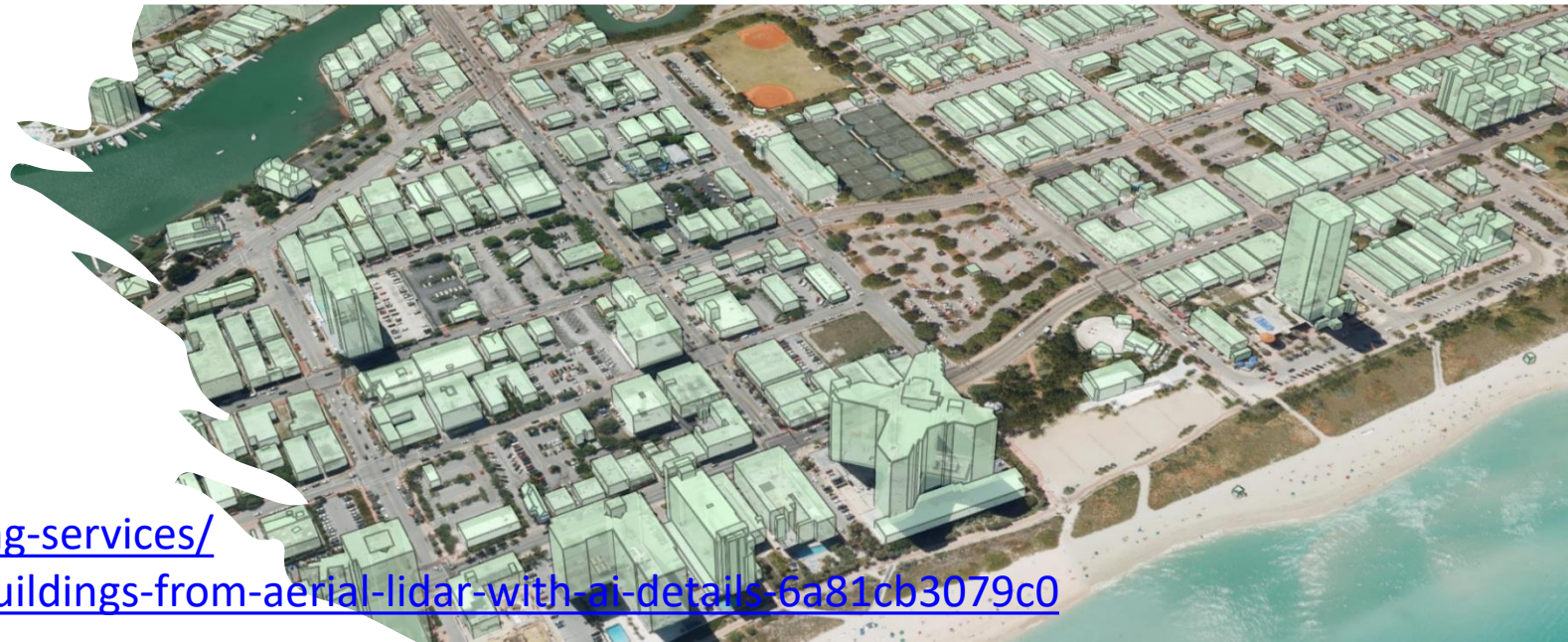
Note: 2D and 3D CAD learn in CAD class

Source: <https://3d-print-works.com/blogs/news/chocolate-3d-printer>



3D Scanning

- Digitally capturing shape of object
- [Milk Scanner](#)
- Reverse engineering (photogrammetry), elevation mapping ([LIDAR](#)), internal body structures ([CT scan](#)), [motion capture](#), Digital avatar ([virtual try-on](#)), Apps on phones

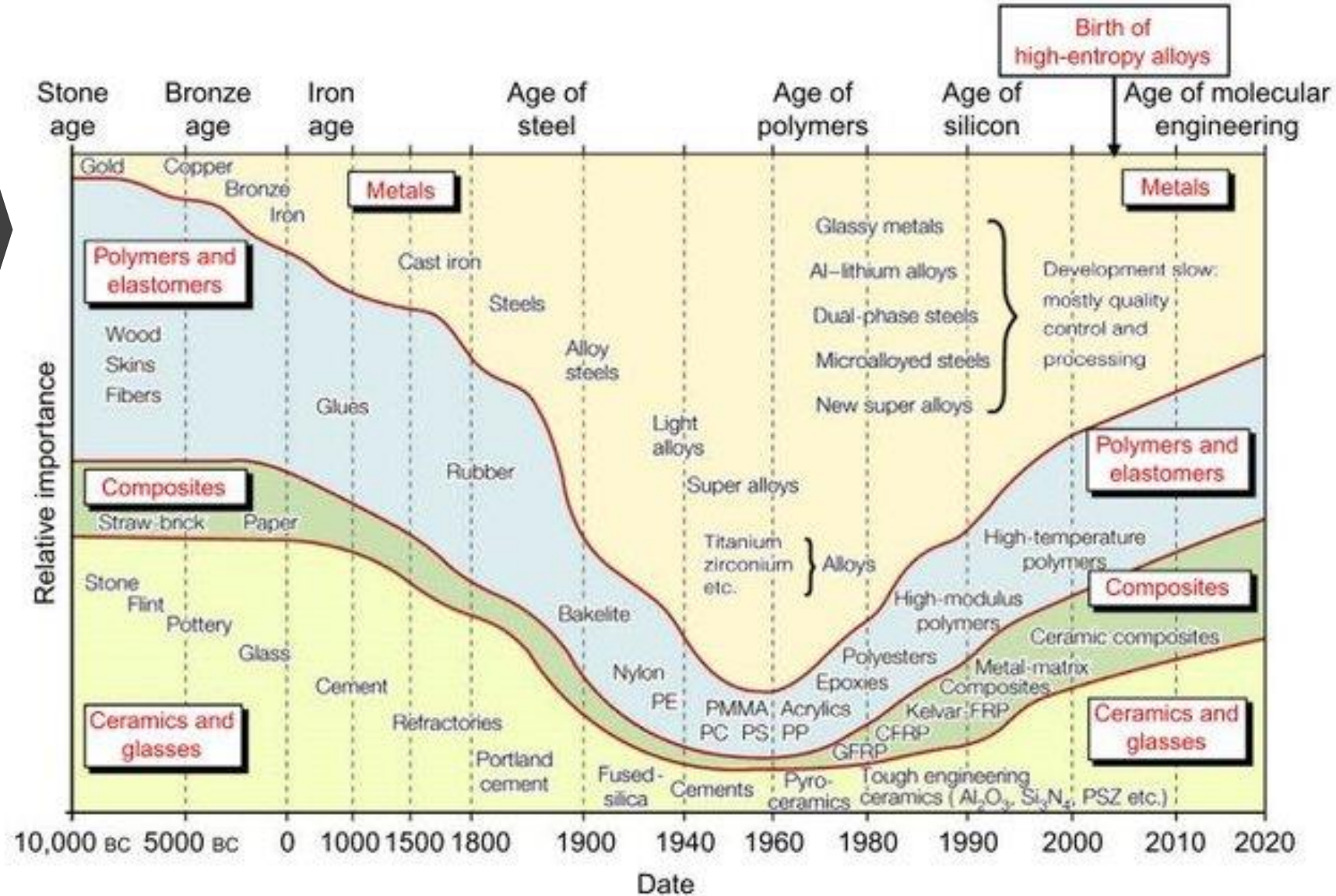


<https://3dtechtronics.com/best-3d-laser-scanning-services/>

<https://medium.com/geoai/reconstructing-3d-buildings-from-aerial-lidar-with-ai-details-6a81cb3079c0>

Topic 6: Materials, DFM/DFA

- Material properties, classification, selection
- Cambridge Engineering Selector
- Design for Manufacture, Design for Assembly considerations
- Manufacturability evaluation

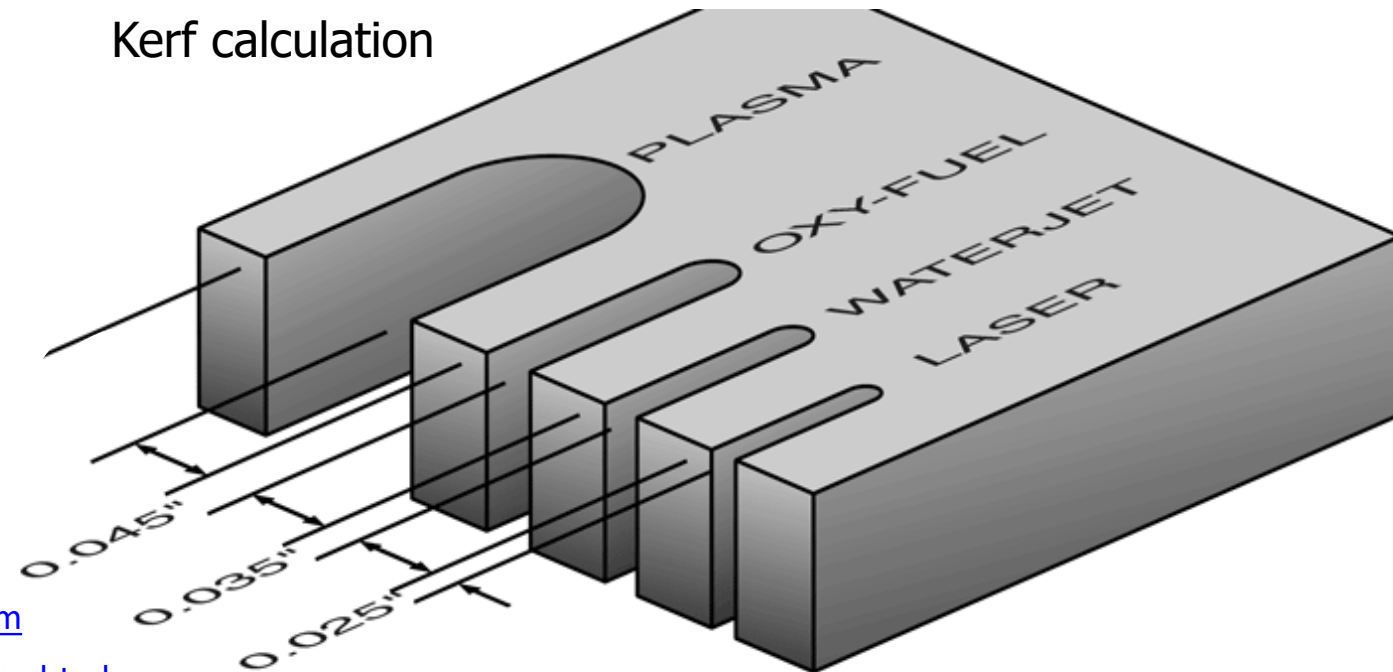


Topic 7: Computer controlled cutting

- Laser, waterjet, vinyl, plasma, wire EDM cutting
- [Machine characterization](#)
- Kerf = f(speed, power, thickness, material)
- Pressfit kit
- Fits and tolerances



Kerf calculation



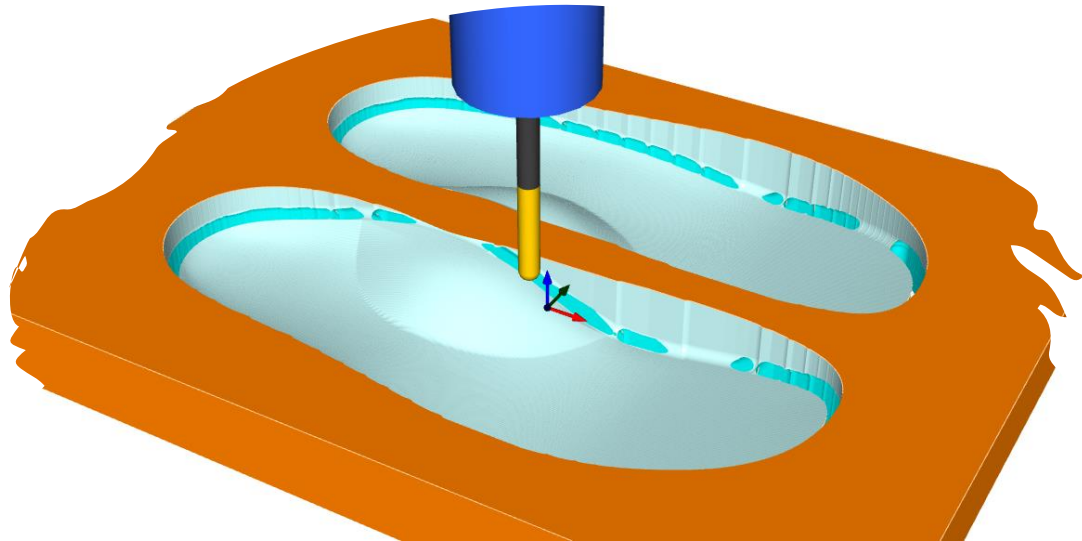
<https://www.esabna.com/us/en/education/blog/what-is-cutting-kerf.cfm>

<http://fab.academany.org/2018/labs/fablabaachen/groupProjects/cutting.html>



Topic 8a: Computer controlled machining

- Subtractive manufacturing
- [Roland MDX-540 3D milling](#), [CNC router 2.5D milling to make something big](#)
- [Custom Orthotic](#), [Opendesk](#), [Shelter](#)
- Make a scaled model first.
- G-code, rough cuts/finish cuts, kerf, test cuts



<https://archello.com/story/15687/attachments/photos-videos/9>

<https://mecsoft.com/blog/orthotic-2-sided-machining-in-rhinocam/>

Topic 8b: Molding and casting

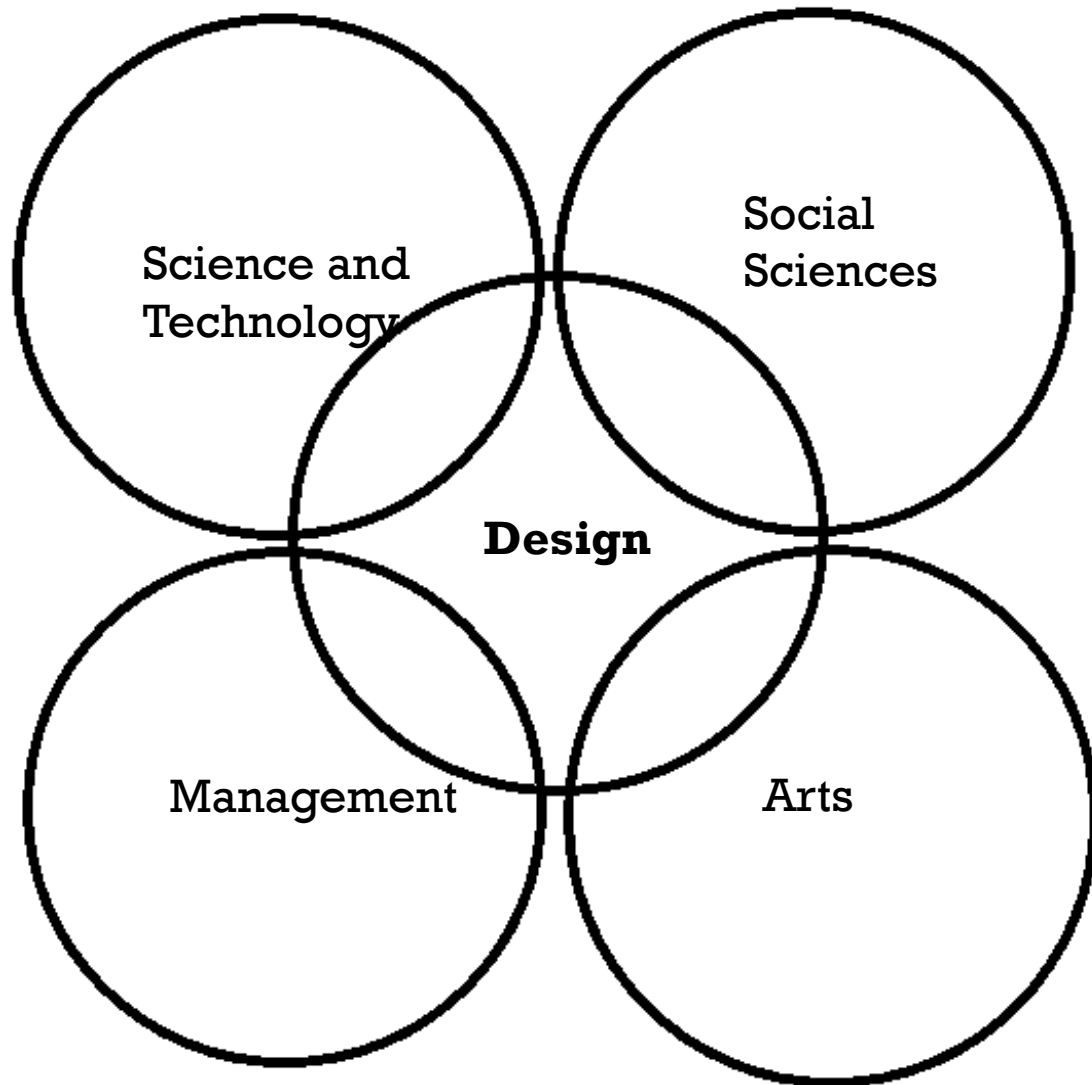
- [Three step process](#) - 1st Mold (wood, wax), counter-mold (silicone), cast (water, epoxy)
- [Vehicle body design](#)
- [sand metal casting](#), [Pewter sand casting](#)
- PDMS molding for micron size devices





Topic 9: Wild Card week

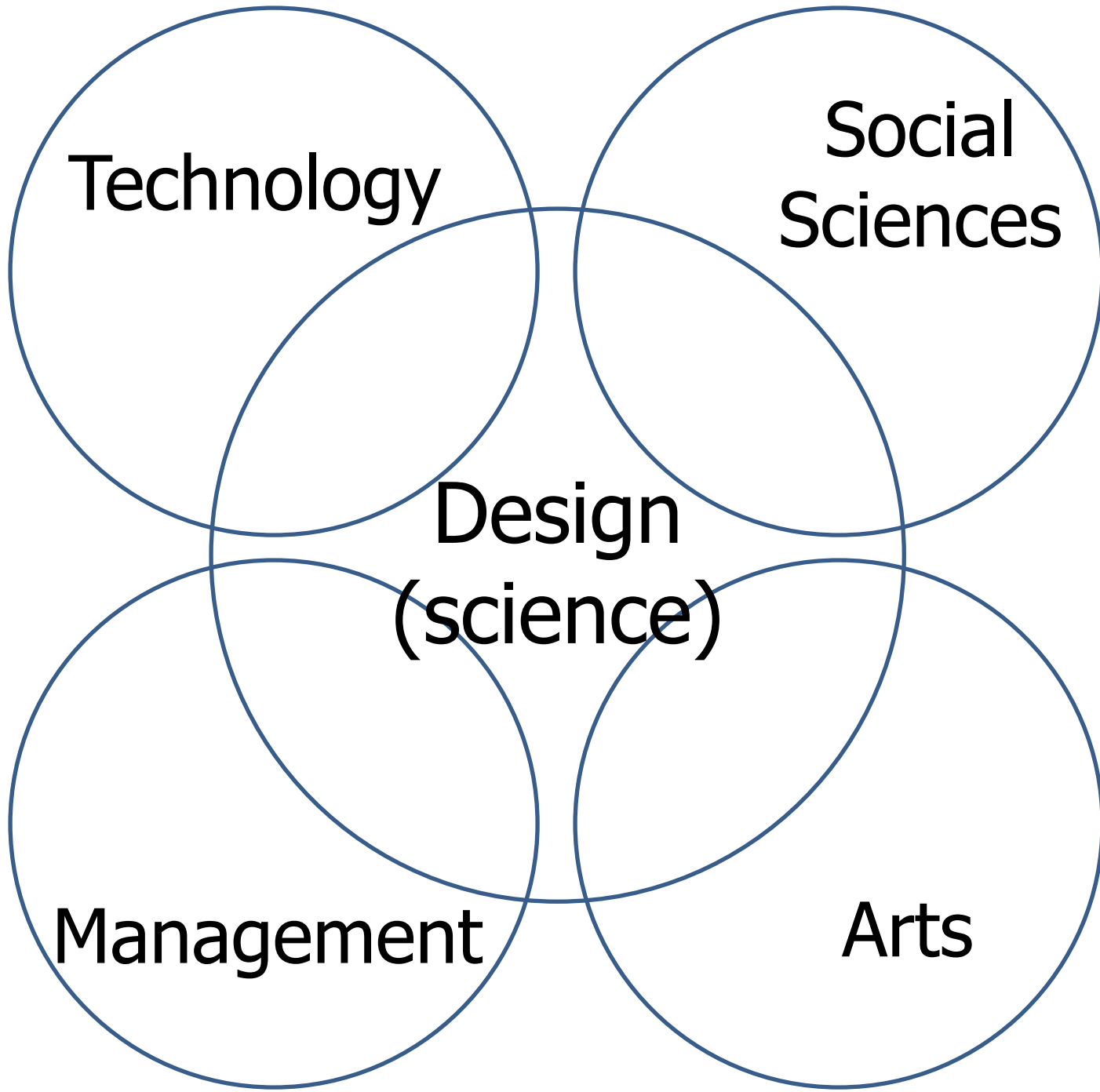
- Visit to Central Workshop (Turning, Foundry, Data science)
- [Mechanical Design](#) and [Machine Design](#)
- Composites [workflow](#) [boat](#) [paddle](#)
- Sand casting
- You can choose your own



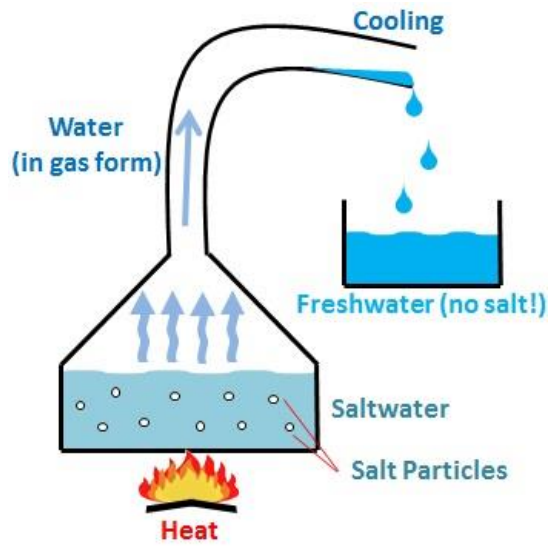
A Vision for Design

To apply design thinking to solve the wicked problems in the society, taking inputs from the sciences and technology, social sciences, management and arts domain as the need may be.

One science, science for impact



First principles method



[Water filter – plant xylem](#)

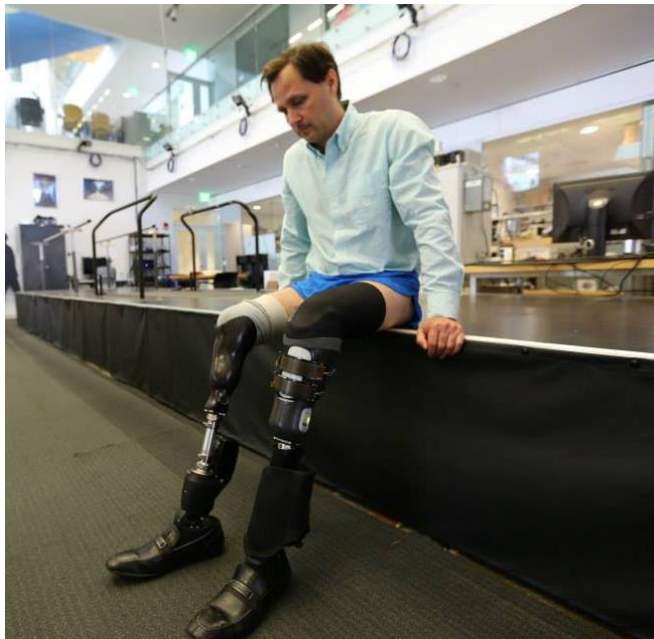
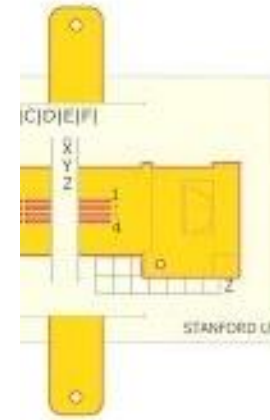


[Waste-water treatment](#)

Biology, Chemical engineering, Mechanical engineering, Nano-technology, Social Sciences

Examples of One Science: SOLVE water

Pranav Mistry's sixth sense device, Dr Abdul Kalam, Manu Prakash's foldscope, Prof Hugh Herr's bionic limbs project



Science for impact

Your introductions

