# Teaching with 3D printed terrain models

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# how to get started

**Workshop, July 13, 2022,  1:30 to 4:00**

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**http://touchterrain.org**

View along the Hong Kong coast

# Workshop goals

- Have a basic understanding of how (low-cost) 3D printing technology works
- Know how to make full use of the TouchTerrain web app for generating 3D printable terrain models (worldwide)
- Develop some ideas for teaching content that incorporates 3D printed terrain

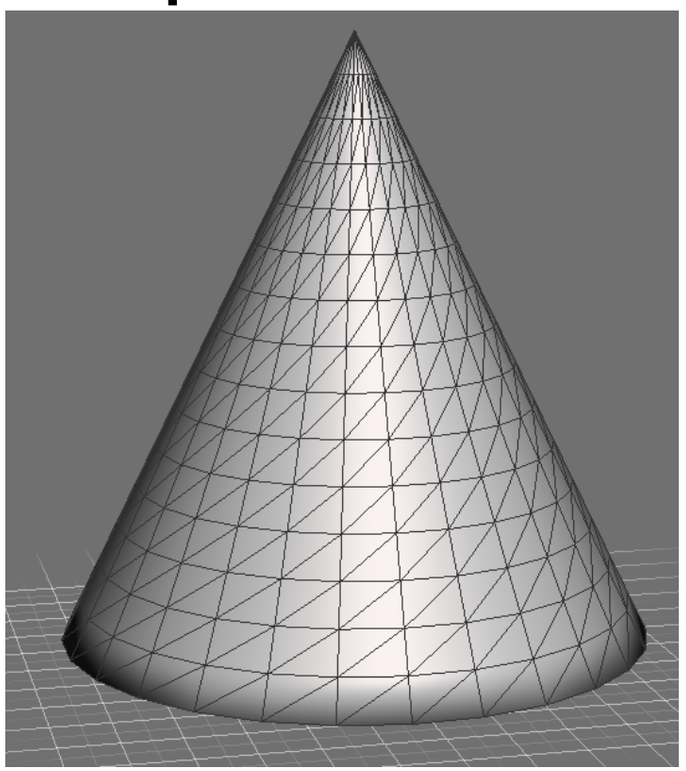
**1:30 - 1:45**

# About myself

- Chris Harding, charding@iastate.edu
- Assoc. professor, Iowa State University (ISU)
- Geology department and Human-Computer Interaction program
- Research: 3D printed, large terrain models, TouchTerrain software
- Teaching: GIS, Python

# Filament-based 3D printing

- “Hot Glue-gun on rails” (Fused Deposition Modeling)
- Slicer software: triangle mesh (STL file) gets converted into (layered) toolhead movement commands
- 1.75 mm thick filament is heated to 210 C and extruded through a 0.4 mm nozzle
- Nozzle deposits filament **tracks** on build plate
- Many tracks create a single (2D) **layer** (“slice”)
- Moves up (0.1 - 0.2 mm), prints next layer
- Final result: 3D object



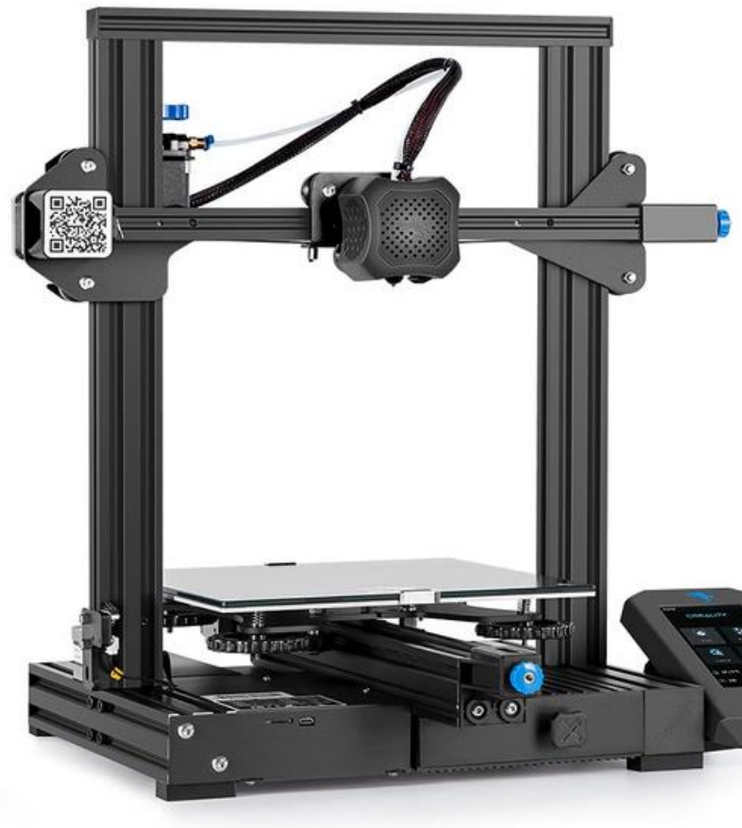
**STL mesh file of a cone**

**1:40 - 1:55**

# 3D mesh model viewer and slicer demo

# Current (low-cost) 3D printing technology

- low- (ish) market segment (hobbyist makers)
- Last 3 – 4 years: many improvements, much lower prices
- Main driver: Chinese race to the bottom (Creality, etc.)
- Slicing software: free (Cura or Prusa slicer)
- Starter: Creality Ender 3 (v2) or clone
- Plate size:  ~250 x 250 mm (10 inches)
- Very nice to haves:
  - Auto bed leveling: ensures a good first layer (first layer = most important!)
  - Flex plate: super-easy to remove large (terrain) print, no scrapy-scrapy



**Creality Ender 3 version 2(!)**
**+ $280**
**+ Good starter printer**
**- No auto bed level, no flex plate**
**- Will need some maintenance sooner**

# Some  $300 – 350 starters

- VOXELAB Aquila **S2(!!!):**
  - 220 x 220 mm
  - flex plate,
  - $300

- Creality CR-6 SE:
  - 235 x 235 mm
  - auto bed level (mechanical)
  - magic glass plate (releases even large prints completely when cooled down!)
  - Dual lead screws (better stability)
  - $350


- Tons of other ender 3 models or Ender 3 clones (YouTube)

# Mid-range starter

- Prusa Mini
- Auto-bed leveling (inductive)
- 180 x 180 mm, flex plate
- Sturdy cantilever, good rods
- Designed to be user-friendly (Prusa chat support)
- (will still need maintenance eventually!)
- $460 (3 month lead time)

# Summary & some tips

- Filament 3D printing is common, easy and affordable
- Slicing software is free (easy but can be very complex)
- If you want to get into “cheap” 3D printing and have a good beginner’s experience, get the Prusa Mini (unless you need larger prints) or the Creality CR 6 SE (bigger but less user friendly)
- BUT: you will eventually need to do maintenance!
- When printing terrain models:
  - Use PLA ($20 for 1 kg), my new favorite: PolyTerra, Color Fossil
  - Use the smallest layerheight your can consistently print well and are willing to wait for (start with around 0.15 mm)
  - If your corners warp (lift off), use some glue stick
  - 10% infill is enough unless you need high impact models

**1:55**