

Props Making

道具制作

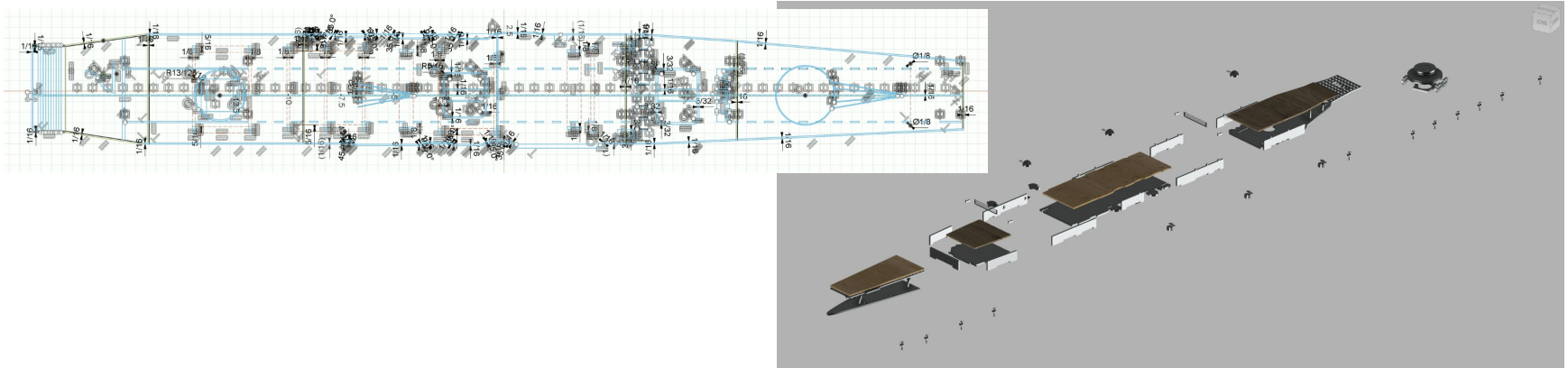
CAD - Computer Aided Design

Blender:

- Open-source professional software

Fusion 360, SolidWorks, FreeCAD:

- Good in flat surfaces (most common in industrial design)



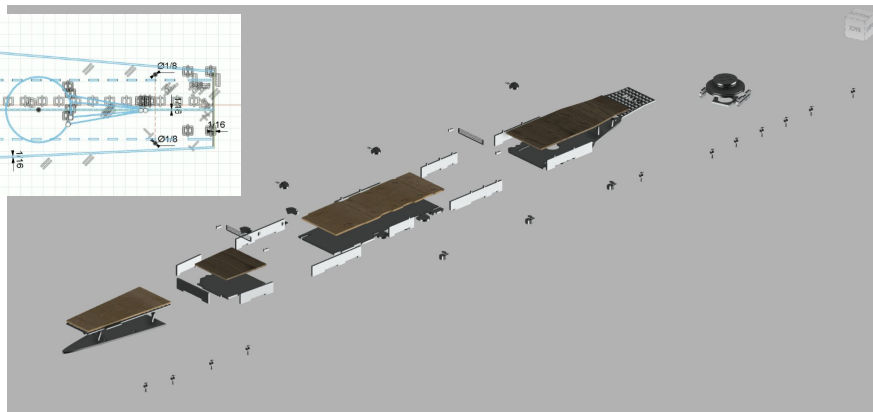
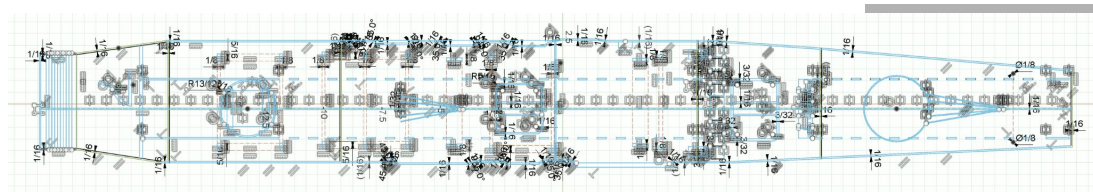
CAD - 计算机辅助设计

Blender:

- 开源专业软件

Fusion 360, SolidWorks, FreeCAD:

- 适合规则形状(主要为工业用)



3D Printer

What's your budget?

Basic vs high-end:

- Basic: Budget-friendly, good for occasional print.
- High-end: \$1000+, fast, reliable, precious, less maintenance, less DIY. If you print a lot, it will worth the invest.

Print size:

- Large print size: Large print table, heavier printer, more expensive and slower.
- Small print size: You need to partition your model, makes design complicate.

Multi-color / multi-material print:

- Support: Expensive printer, heavier printer (slower and smaller work area), waste material when changing.
- Non-support: Print multiple parts then assemble, require more consider during design.

3D打印

预算够不够？

基本款与高级款：

- 基本款：便宜，适合入门与偶尔打印。
- 高级款：\$1000+，打印快、可靠、精确，不需要太多维护，也不需要太多魔改。如果打印的多，那就能值回打印机价格。

打印体积：

- 大体积：更大的机器，更重、更贵、更慢（打印头与支架惯性）。
- 小体积：需要切分模型分段打印，设计会变复杂。

多色/多材料打印：

- 支持：打印机贵且重，且会牺牲打印体积和速度，切换材料时会有浪费。
- 不支持：分别打印后组装，需要在设计时考虑更多细节。

3D Print Materials

PLA / Metallic PLA / Transparent PLA:

- Most common material, easy to print and cost friendly

Fluorescence PLA:

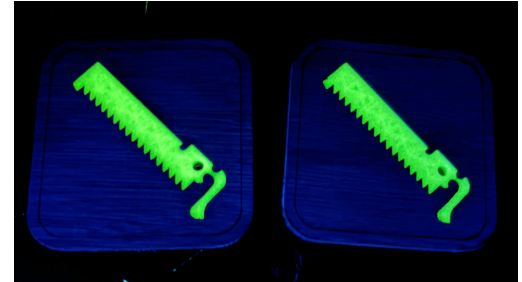
- Glow in the dark
- Hard powder, wears print nozzle

Carbon Fiber PLA:

- Strong!!!

Wood blend PLA:

- Wood color, semi-wood texture
- Prone to clog



3D打印材料

PLA/金属色PLA/透明PLA:

- 最常见, 很好打印, 也很便宜

荧光PLA:

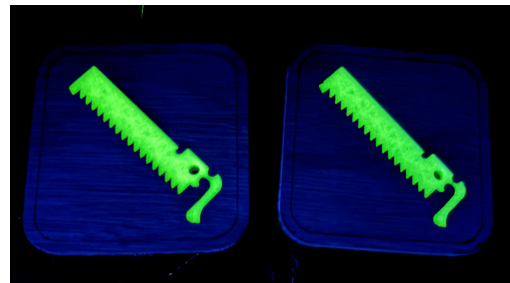
- 夜里发光
- 粉末硬度高, 磨损打印喷头

碳纤维PLA:

- 结构超级强!

木头PLA:

- 木头色, 模仿(但不完全)木头质感
- 容易堵



3D Print Materials

ABS:

- Toxic when print

TPU:

- Soft, like rubber
- Hard to print

PETG:

- Strong
- Hard to print

3D打印材料

ABS:

- 打印时会释放有毒气体

TPU:

- 软材料, 类似橡胶
- 很难打

PETG:

- 结构强
- 很难打

3D Print Structural Considerations

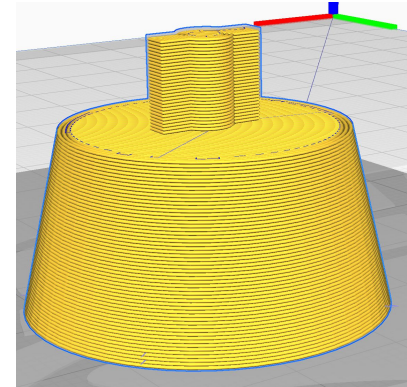
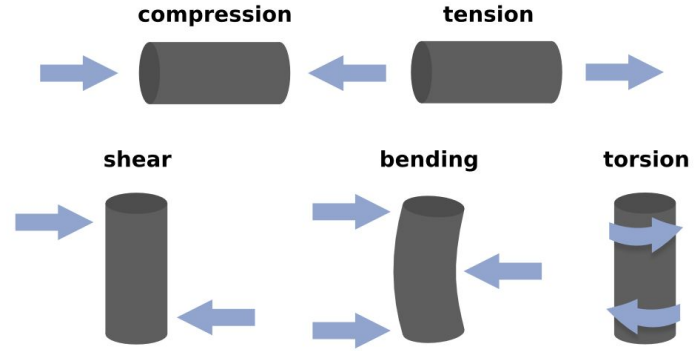
Print is performed layer-by-layer (z-axis)

- Strong/continuous in xy-direction.
- Weak/discrete in z-direction.

Compress: Excellent in all direction!

Tension: Excellent in xy-direction, poor in z-direction.

Shear: Poor in xy-direction, good in z-direction.



3D打印结构强度

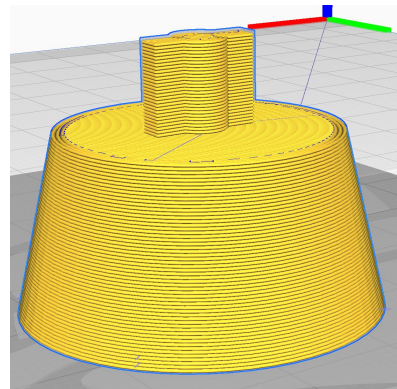
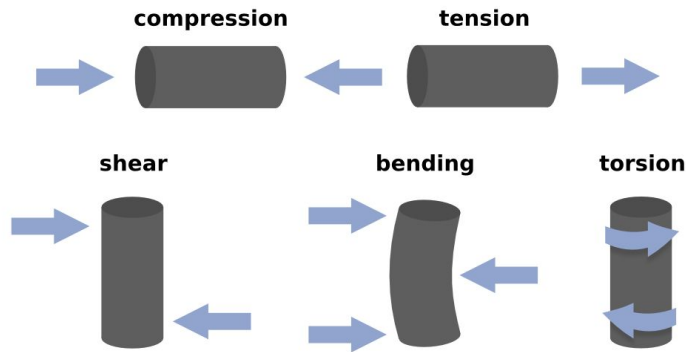
打印机通过一层一层的方式打印(z轴)

- xy轴强度高
- z轴不连续, 所以强度低。

压缩: 所有方向都无压力。

拉伸: xy轴方向强度高, z轴强度低。

剪切: xy轴方向强度低, z轴强度高。



3D Print Pros and Cons

Pros:

- Cheap material
- Create any shape
- Find a model file and start print

Cons:

- Slow
- Poor structural
- You may need to create the model

3D打印优缺点

优点:

- 材料便宜(PLA=\$20/kg)
- 任意形状
- 网上找个模型就可以直接开打

缺点:

- 慢
- 强度低
- 找不到模型就要自己画

Laser Cut

Hobby grade (LED, <50w):

- Wood, MDF, Plywood
- Thin metal (<2mm or 1/16-in)
- Dark-color plastic and acrylic
- TONS of DIRTY smoke!

Industrial grade (CO2, 100w+):

- Heavy gauge metal
- Expensive
- 3-ph industrial power supply required
- Better send your design to professional shops (however, most shops are B2B only)



FAST, but FLAT panels only

激光切割

爱好级(LED, 小于50W):

- 木头、纤维板、三合板
- 薄金属(<2mm或1/16英寸)
- 深色塑料、亚克力
- 发烟严重

工业级(CO2, 大于100W):

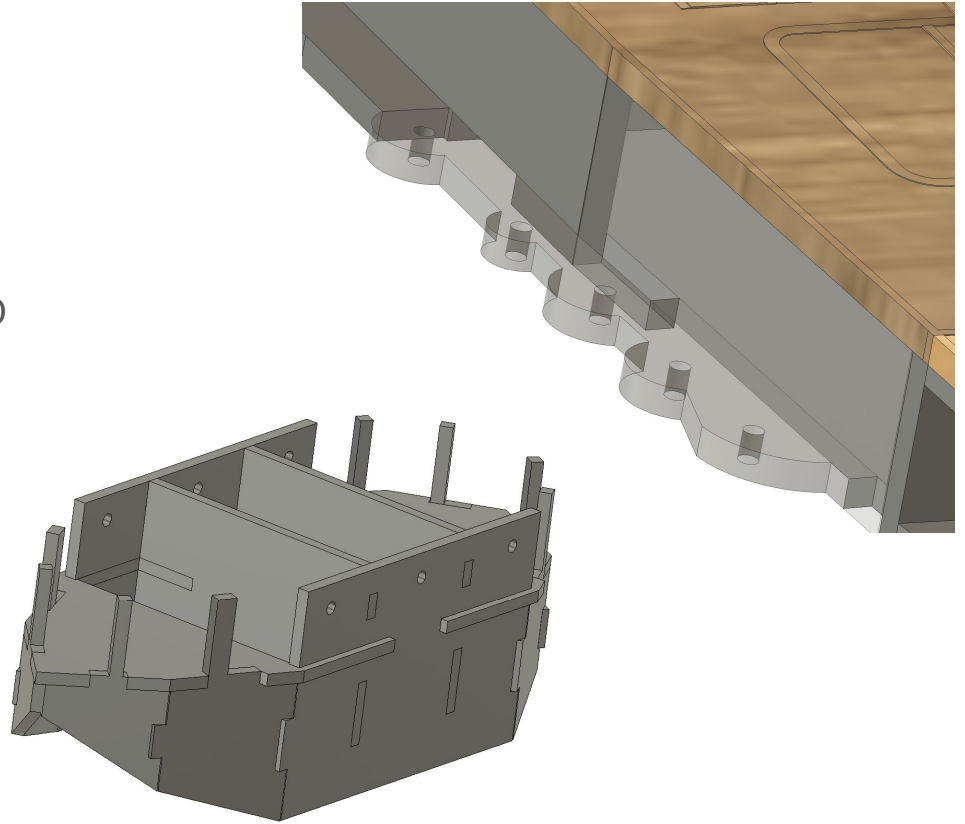
- 厚金属
- 贵
- 需要三相电
- 最好直接把文件发给专业工厂(但是很多工厂只对C端)



快速, 但是只能制作平面

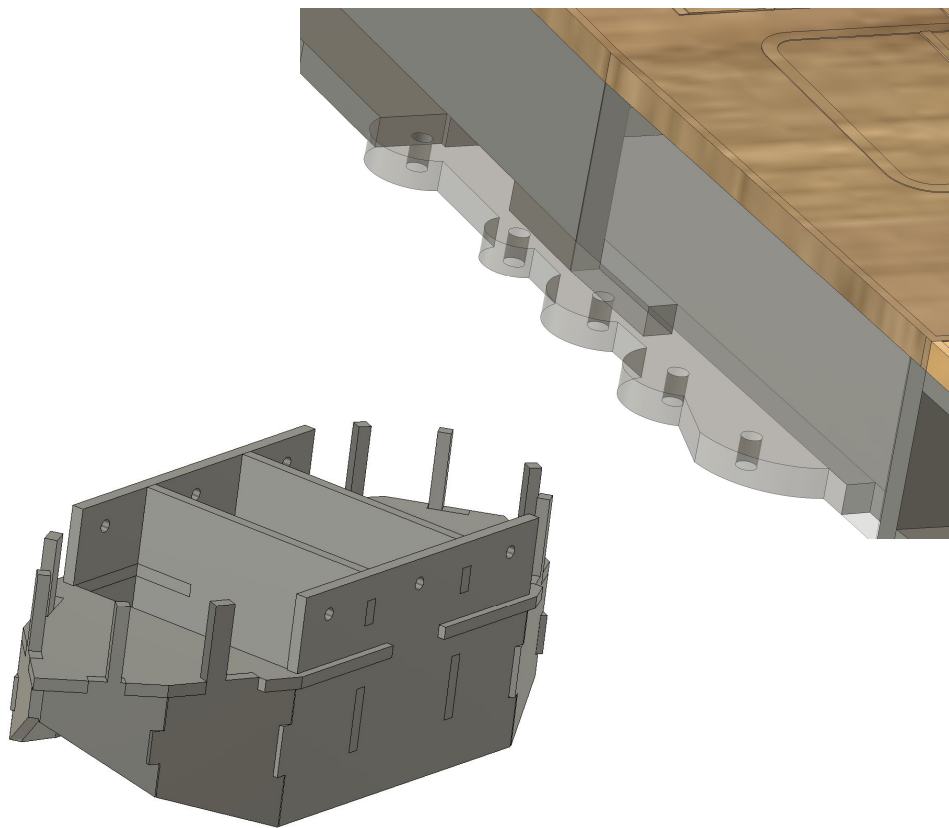
Design for Laser Cutting

- Flat surface ONLY!
- Use flat surfaces to mimic a non-flat surface.
- Assemble multiple flat panels to create 3D structure.
- When design, leave Mortise and Tenon to help assemble.



激光切割设计

- 只能是平面！
- 使用多个平面来模仿曲面。
- 将多个平面组装为3D结构。
- 设计时，记得留下组装用的榫卯结构。



Plywood vs MDF

Plywood (multi-layer wood plates):

- Strong (3+ layers of wood, crossed, glued)
- Waterproof
- **Wood texture**
- Light-weight



MDF (Middle density fiberboard):

- Mid
- Dissolve in water (MDF is glued powder)
- Uniform texture
- Heavy



三合板与纤维板

三合板(又多张木板压制):

- 强度高(三层以上木板垂直相交)
- 防水
- 木头的质感
- 重量轻



纤维板:

- 中等强度
- 溶于水(纤维板由粉末粘接)
- 质感均匀
- 重量重

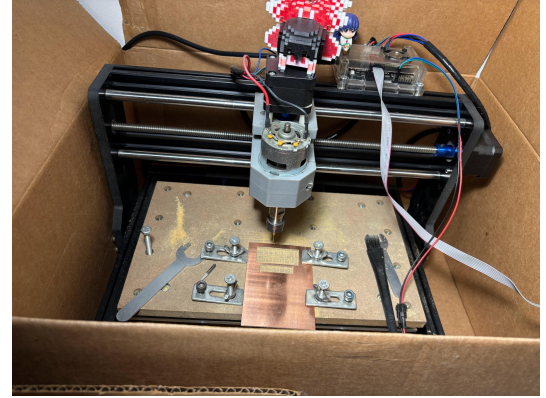


CNC

Industrial grade and hobby grade

Almost any hard material (plastic, wood, metal)

Very loud, and dangerous (snap spindle)

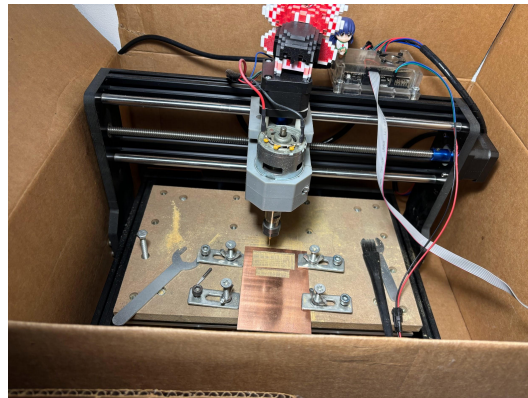


CNC

有工业级与爱好级

可以加工任何硬质材料(木板、塑料、金属)

很吵, 而且危险(不好好操作就会撞刀)



Consider Other (Off-shelf) Materials

Your best friends: Dollarama, Lows, Rona, Home Hardware

- Metal bars and broomstick
 - Extremely hard, excellent for structure purpose
 - Heavy, may be banned in some cons
 - Hard to cut and glue, need plasma cutter and welder
- Wood (plywood, MDF) panel and rod:
 - Hard, light, good for structure purpose
 - Cut with saw, table saw or laser cutter
- PVC pipes:
 - Hard but flexible
 - Cut with saw
- EVE:
 - Soft material
 - Easy to cut, hand cut with knife
- Form sheet:
 - Hard material
 - Easy to cut, hand cut with knife

Home Depot?

More expensive in most cases,

But offers cutting services.

Check their price first.

If you can buy it with a reasonable price, don't make it.

You end up spending more time, more money, and worse product.

考虑其它(现成)材料

藏宝库: Dollarama, Lows, Rona, Home Hardware

- 金属棍与扫把滚
 - 强度超高, 非常适合作为结构件
 - 重, 且可能进不了有的漫展
 - 不好切割与粘接, 需要等离子切割与电焊
- 木头(三合板、纤维板)板与棍:
 - 强度高、重量低, 适合作为结构件
 - 用锯子就可以加工, 也可以用台锯与激光
- PVC水管:
 - 硬但有弹性
 - 用锯子就可以加工
- EVE:
 - 软
 - 美工刀就能切
- 泡沫板:
 - 硬
 - 美工刀就能切

Home Depot?

价格贵, 但是有时会有deal

提供简单切割服务

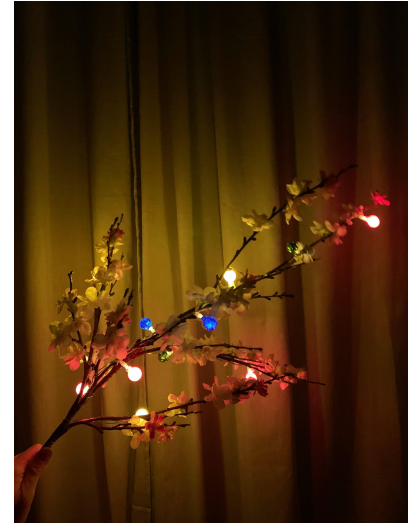
最好先比较价格

能便宜买到OK的道具就不要自己搓。
不然费事费钱还可能不好看。

Light Up!

Adding lights to your props!

- Constant light: Get a light string from Dollarama.
- Flicker: Get a christmas light string from Dollarama.
- Flowing: Search for “W2812 light bar” on Amazon:
 - You will get a light bar/string and a controller with some pattern in it.
- More complex pattern?
 - You will need to design your light circuit and controller.
 - Arduino is a good starting point for beginner.



神说，要有光

给道具添加光效

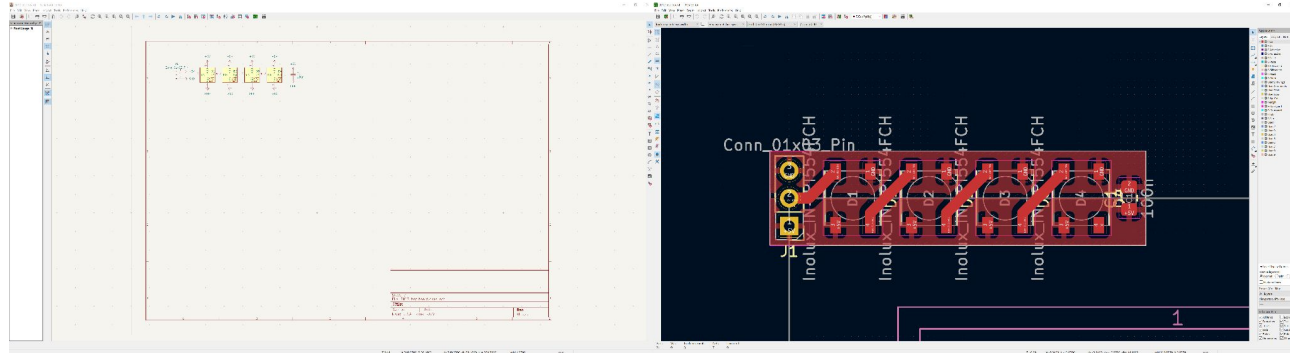
- 常亮: 去Dollarama买一条灯带。
- 闪烁: 等圣诞节去Dollarama买一条灯带。
- 流水灯: 去Amazon找“W2812 light bar”:
 - 你会买到一根灯条和一个包含了几种模式的控制器。
- 更复杂的模式？
 - 你得自己设计电路和控制器。
 - 可以使用Arduino入门。



Circuit - Complex functionalities

Embedded system design: PCB, MCU and outputs(actuators).

- PCB: The circuit - KiCAD
- MCU: The control - Arduino (AVR), STM32 and Pico (ARM Cortex-M), ESP32
- Outputs:
 - Lights (LED)
 - Servo
 - Speaker



电路 - 更复杂的功能

嵌入式系统: 电路板、单片机、输出。

- 电路板: 电路载体 - KiCAD
- 单片机: 控制器 - Arduino (AVR), STM32 and Pico (ARM Cortex-M), ESP32
- 输出:
 - 灯光(LED)
 - 舵机
 - 音响

