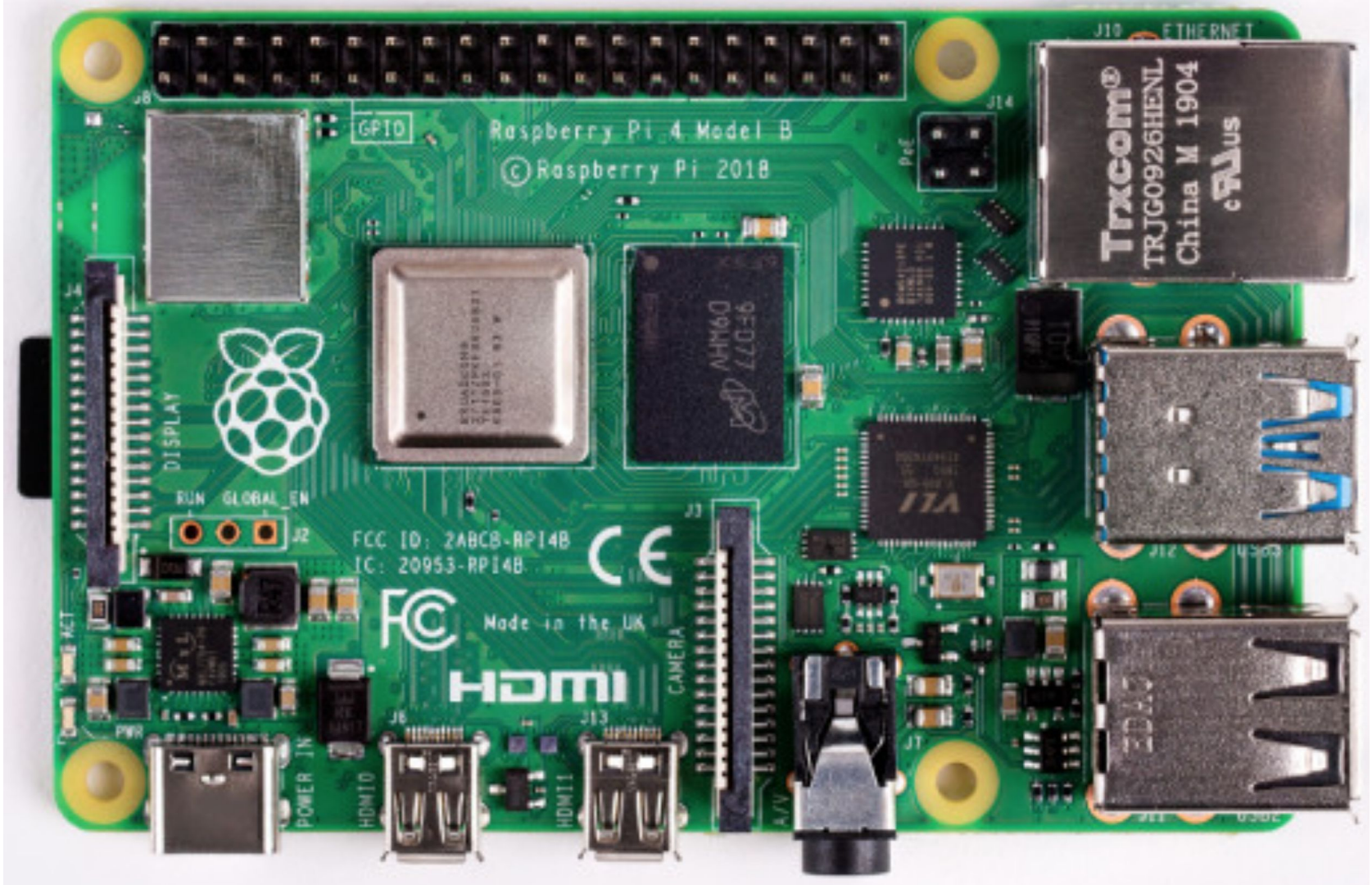
Teaching the Systems Course with Raspberry Pi Kits

The kits

The course

- CS 241, *Hardware Design*
- Gentle introduction to computer systems, computer organization, and parallel computing. Prereq: CS1
- C programming, Raspberry Pi with laptop as only platform
  - Includes assembly programming (ARM)
- Daily individual in-class worksheets; occasional homework
  - Experiment with new tech; review for quiz
- 40-45 students in the section (our largest class)


Raspberry Pi 4 Model B
©Raspberry Pi 2018
GPIO
ETHERNET
Trxcom®
TRJG0926HENL
China M 1904
DISPLAY
RUN GLOBAL_EN
FCC ID: 2ABCB-RPI4B
IC: 20953-RPI4B
Made in the UK
HDMI
CAMERA
POWER IN
HDMI0
HDMI1
A/V
PWR
PoE

Raspberry Pi as a learning platform

- Tactile understanding of the components
- See the bus
  - Assembly - registers vs memory
- Using a system in the wild
  - Power Pi completely down, vs git
- Networking to other systems
  - Laptop
  - Lab machines
  - Tactile experience of networking!
  -

PDC in the Systems course using Raspberry Pi

- OpenMP Integration example
  - Using the multiple cores
  - Race conditions
    - Reason out in class among least experienced students.
- Pthreads implementation of Drug Design
  - First C program entered (HW1)
  - Running the program - in-class, after OpenMP example
    - Continued in homework

Student collaborators

- Early undergraduate researchers
- Max's leadership on the kits
  - Background; details
- TA team
- Further developments
  - e.g., system image managed by ansible scripting