Embedded Linux workshop

C programming for Raspberry Pi

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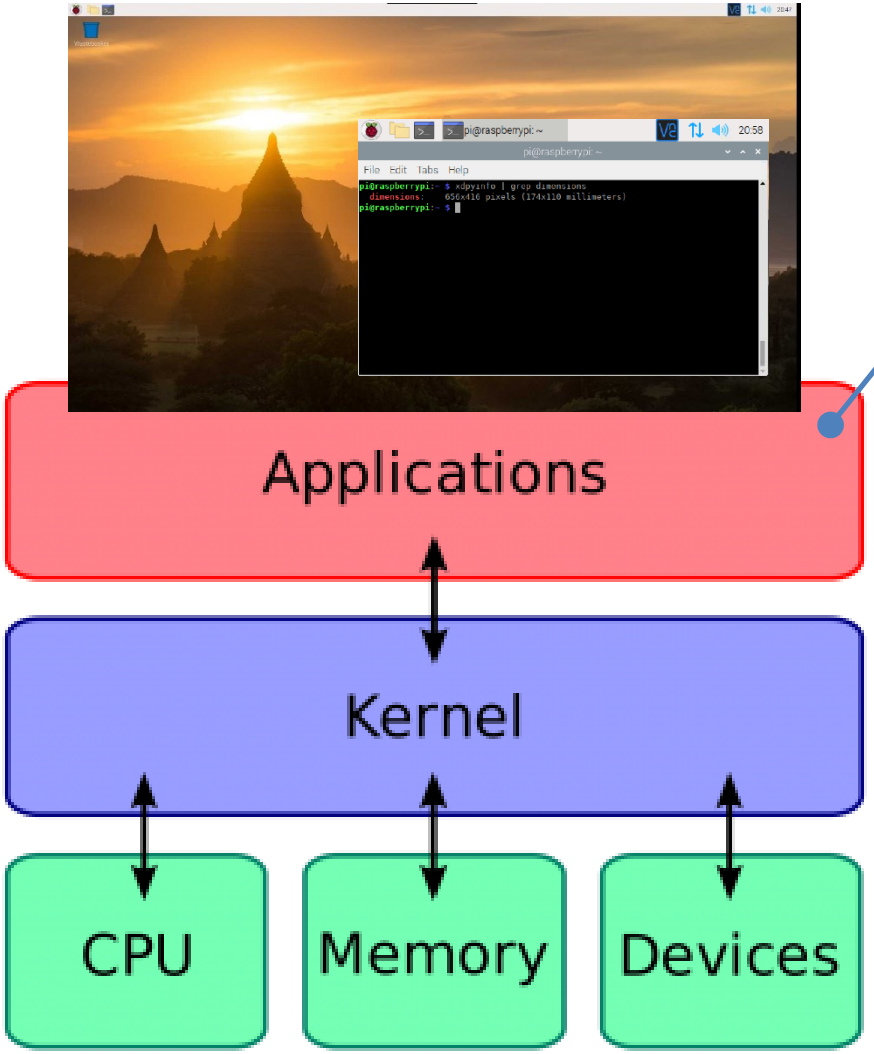
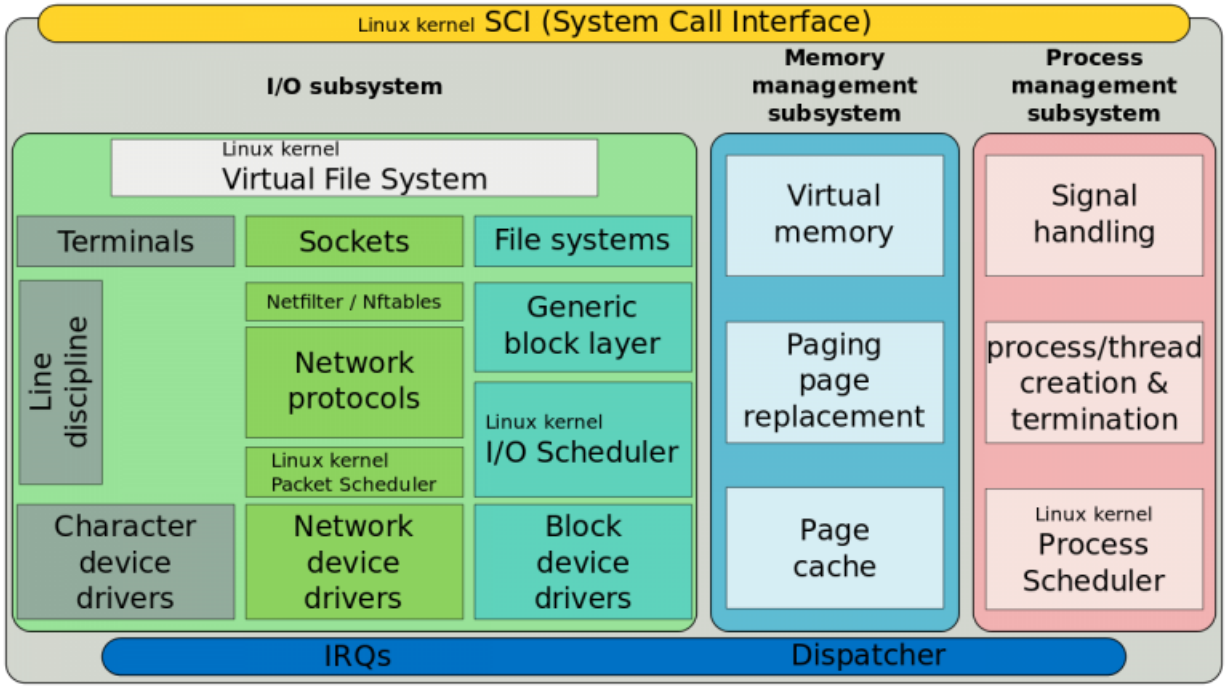
Linux architecture



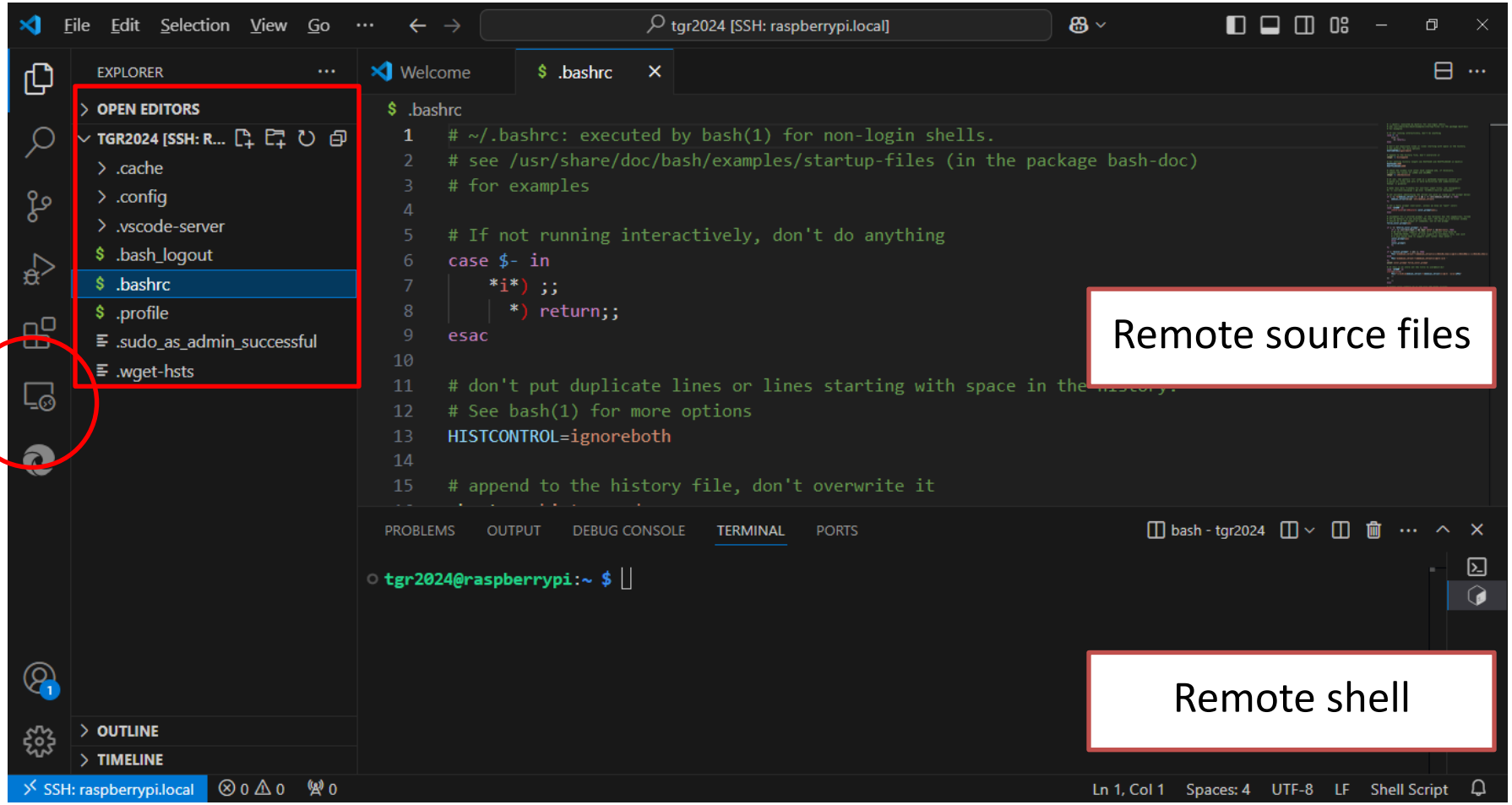
- Application
- Programming environment
- Library
- Shell
- Filesystem



VS Code + Remote Explorer extension

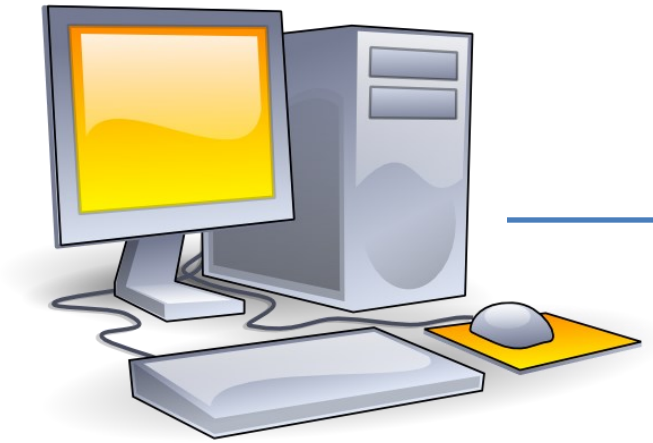
Remote Target

Remote Explorer Extension



Practice #1: headless dev. workflow

Host computer



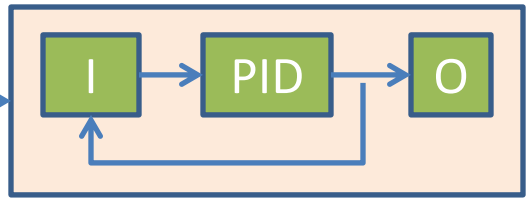
Native development

Cross-platform development

```
#include <stm32.h>
int main() {
  platform_init();
  while(1) { ... }
}
```

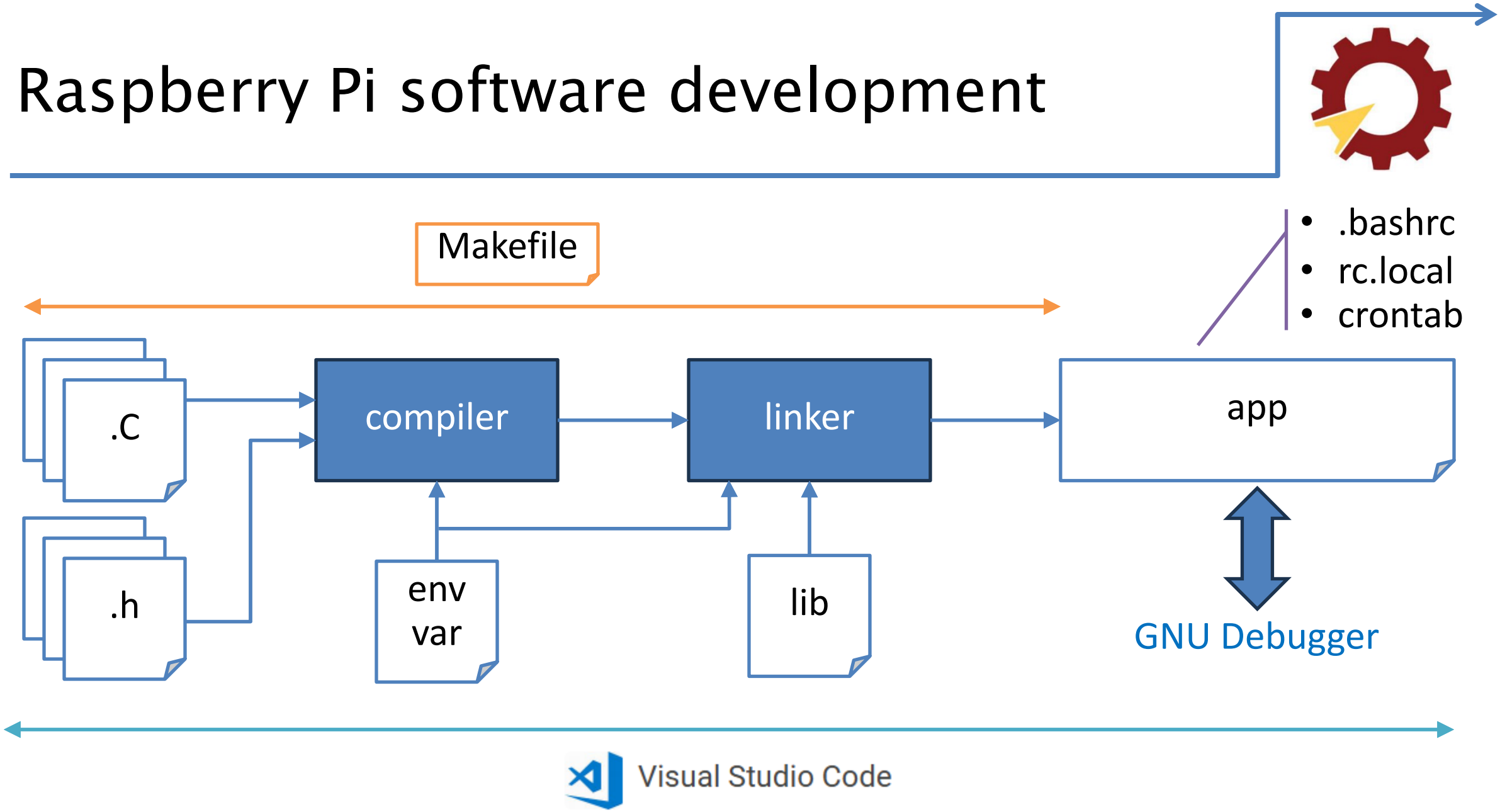
```
#include <stdio,h>
int main() {
  printf("hello");
}
```

Linux OS

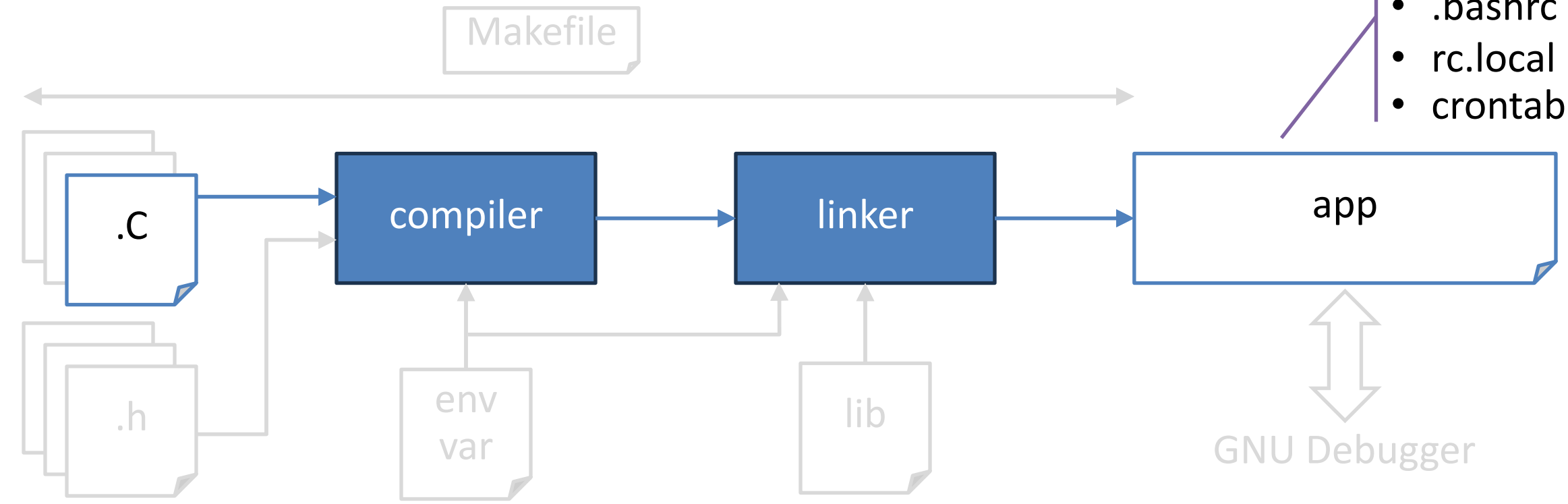


MATLAB/Simulink

Raspberry Pi software development

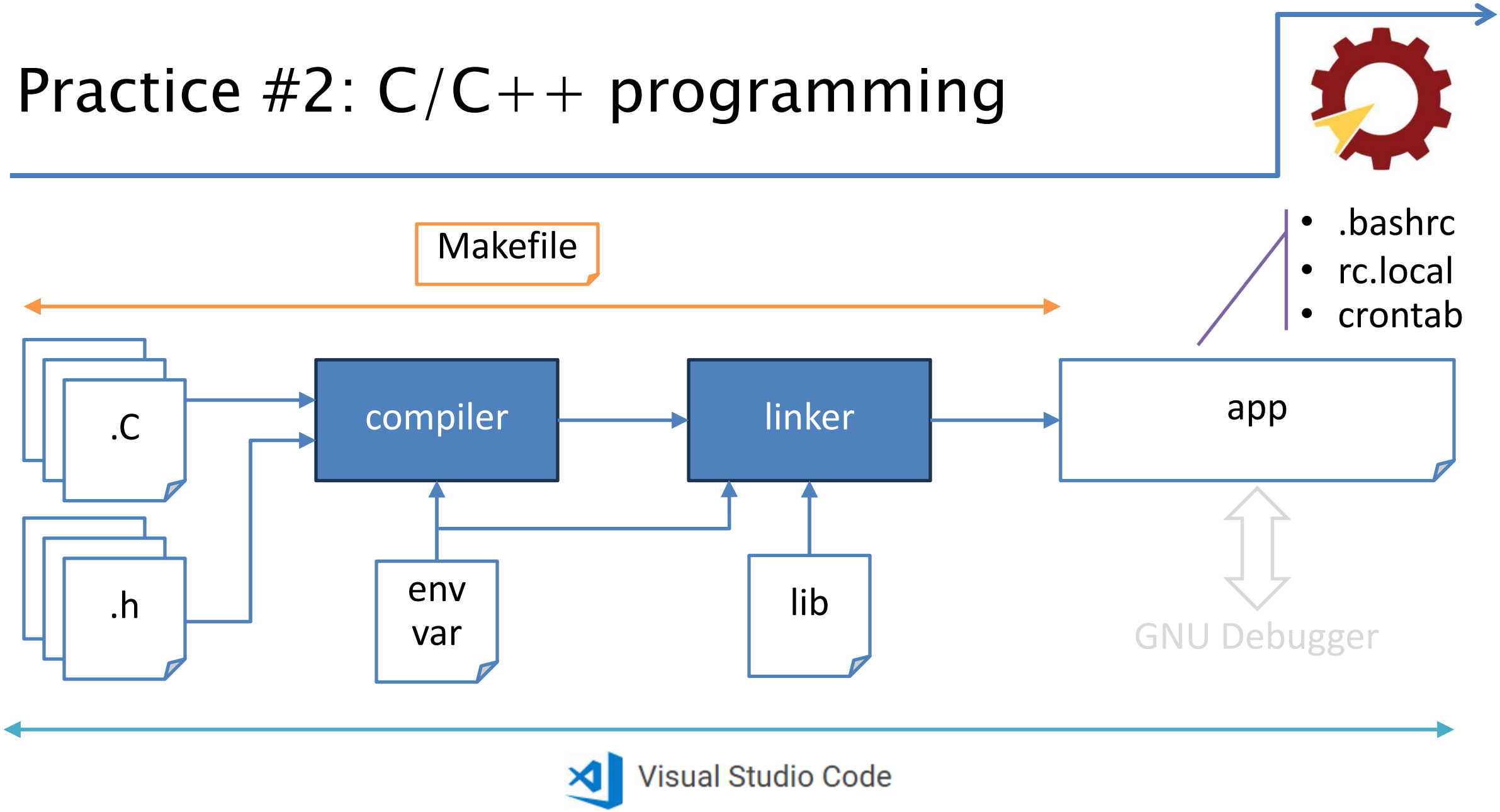


Practice #2: C/C++ programming

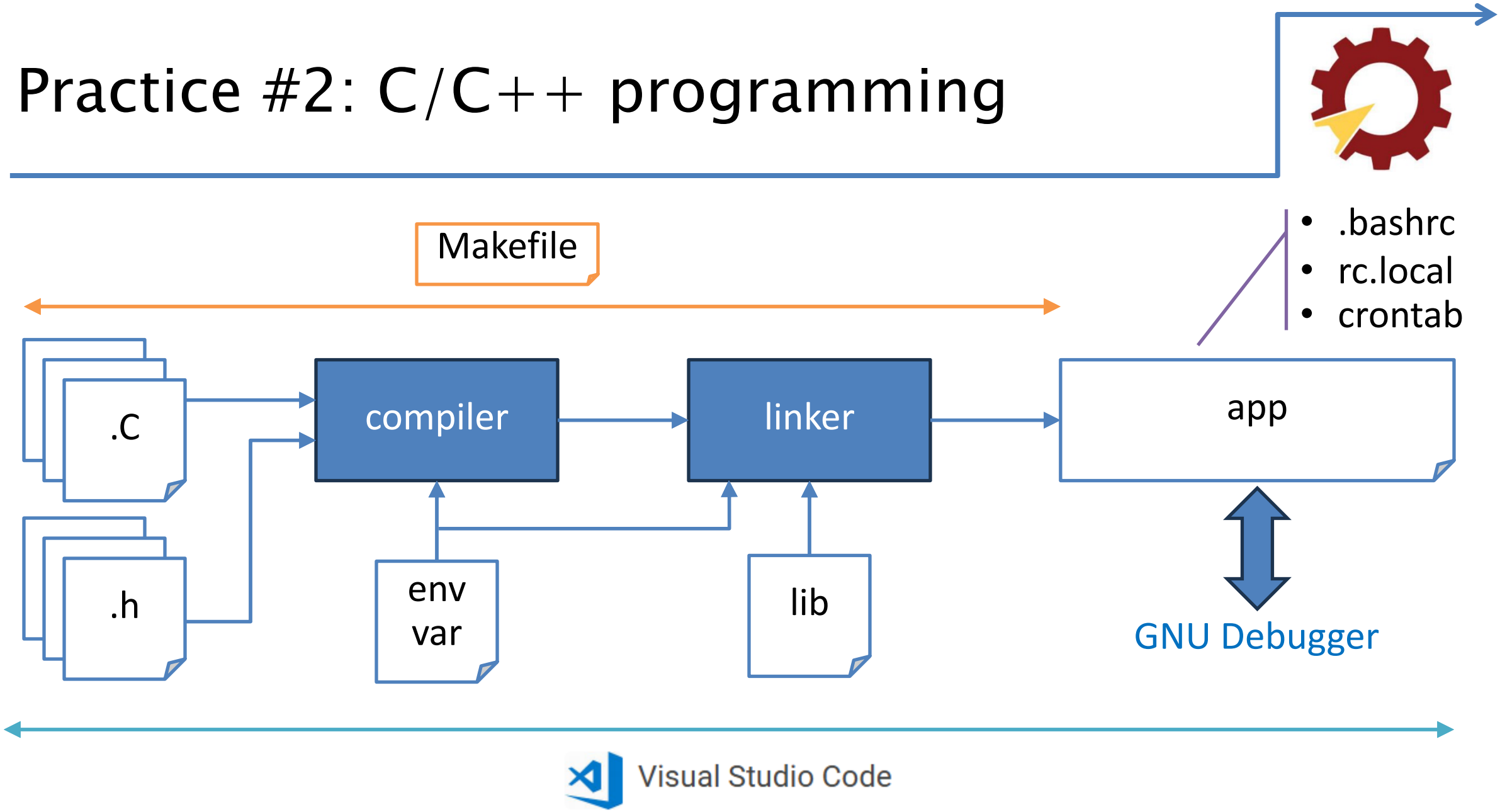


Visual Studio Code

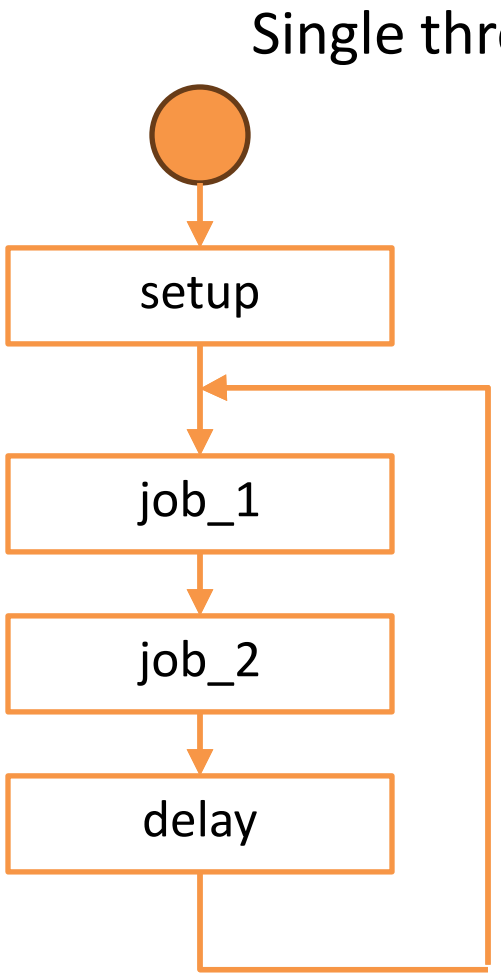
Practice #2: C/C++ programming

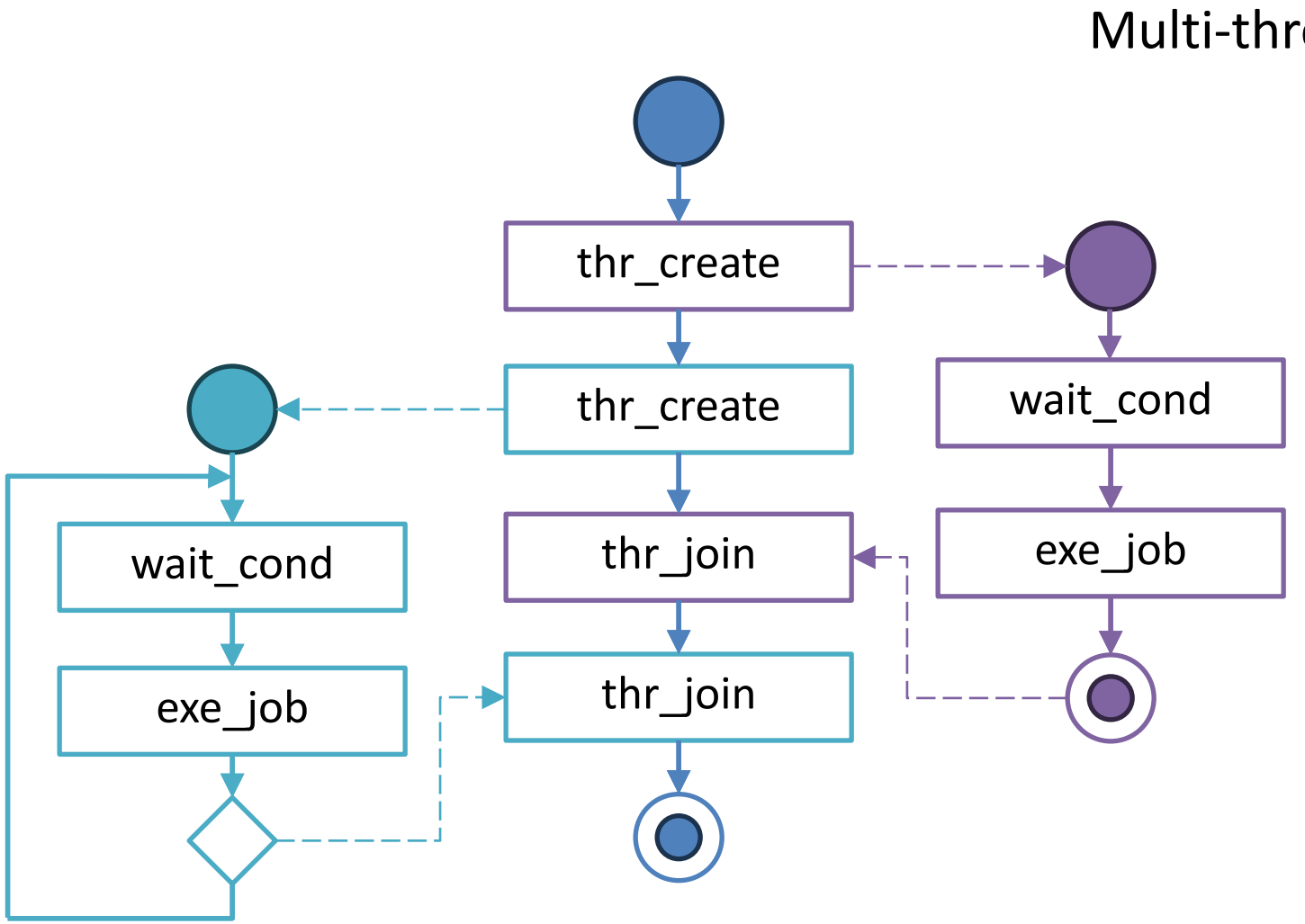


Practice #2: C/C++ programming

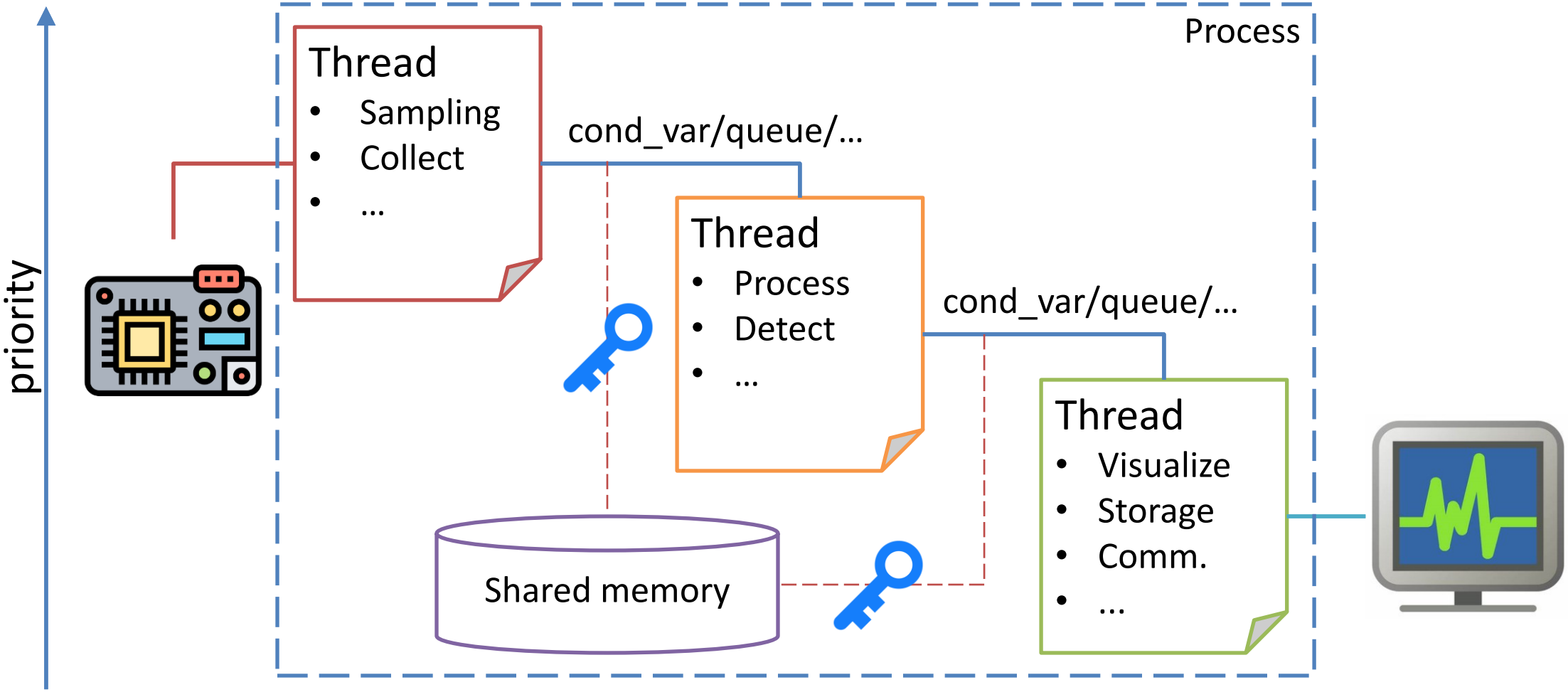


Real-time multi-thread programming

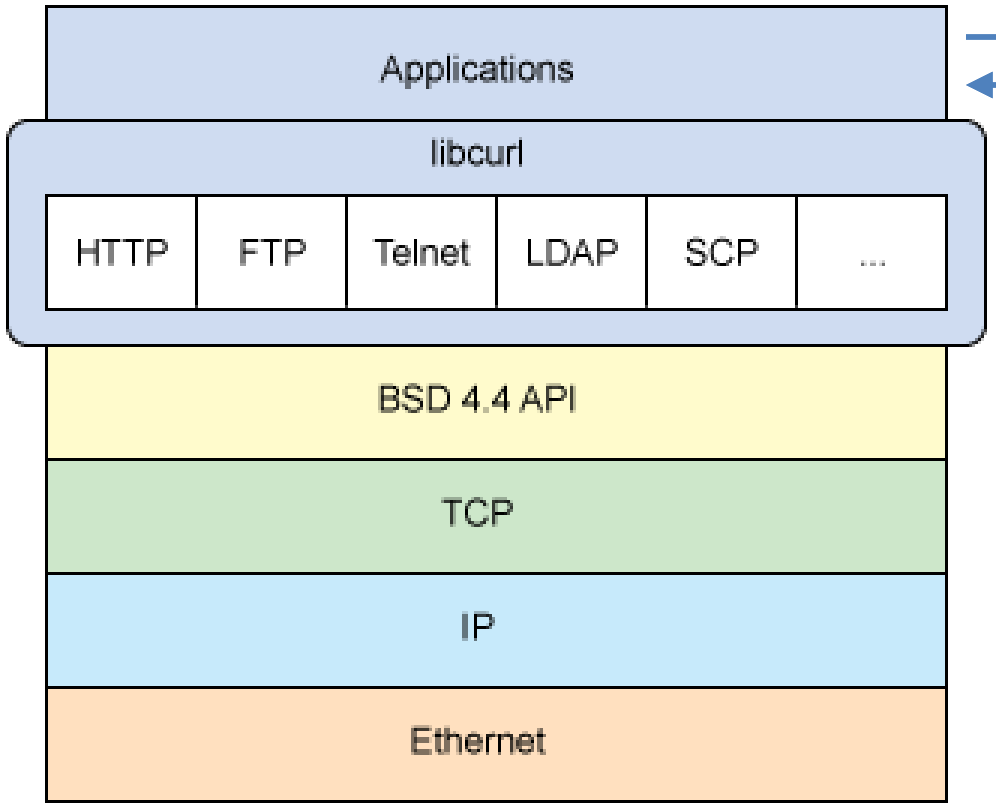




Practice #3: multi-thread programming



Networking programming: cURL



HTTP request: URL, verb, body

HTTP response: header, body

Application layer

Sockets layer

Transport layer

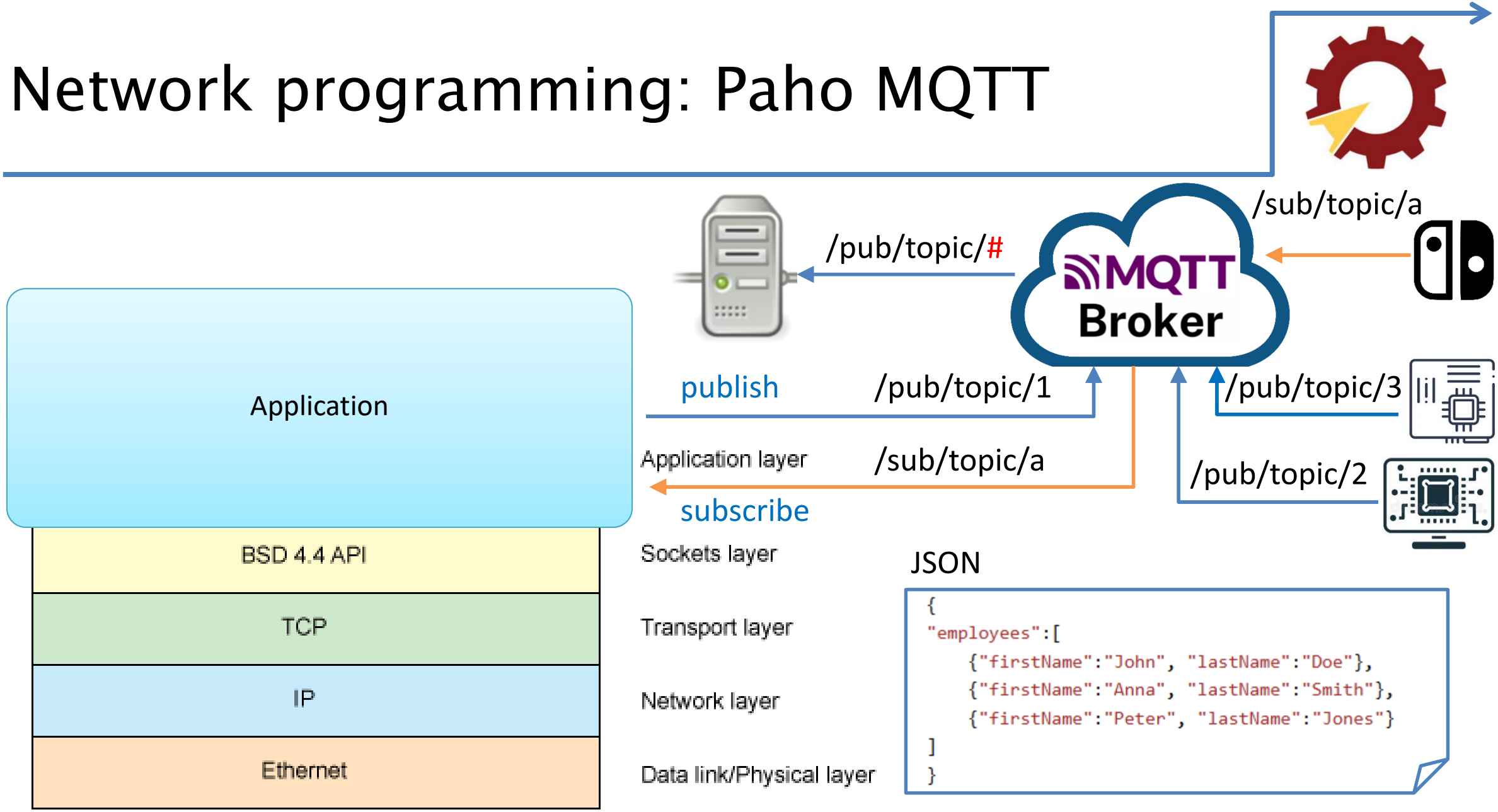
Network layer

Data link/Physical layer

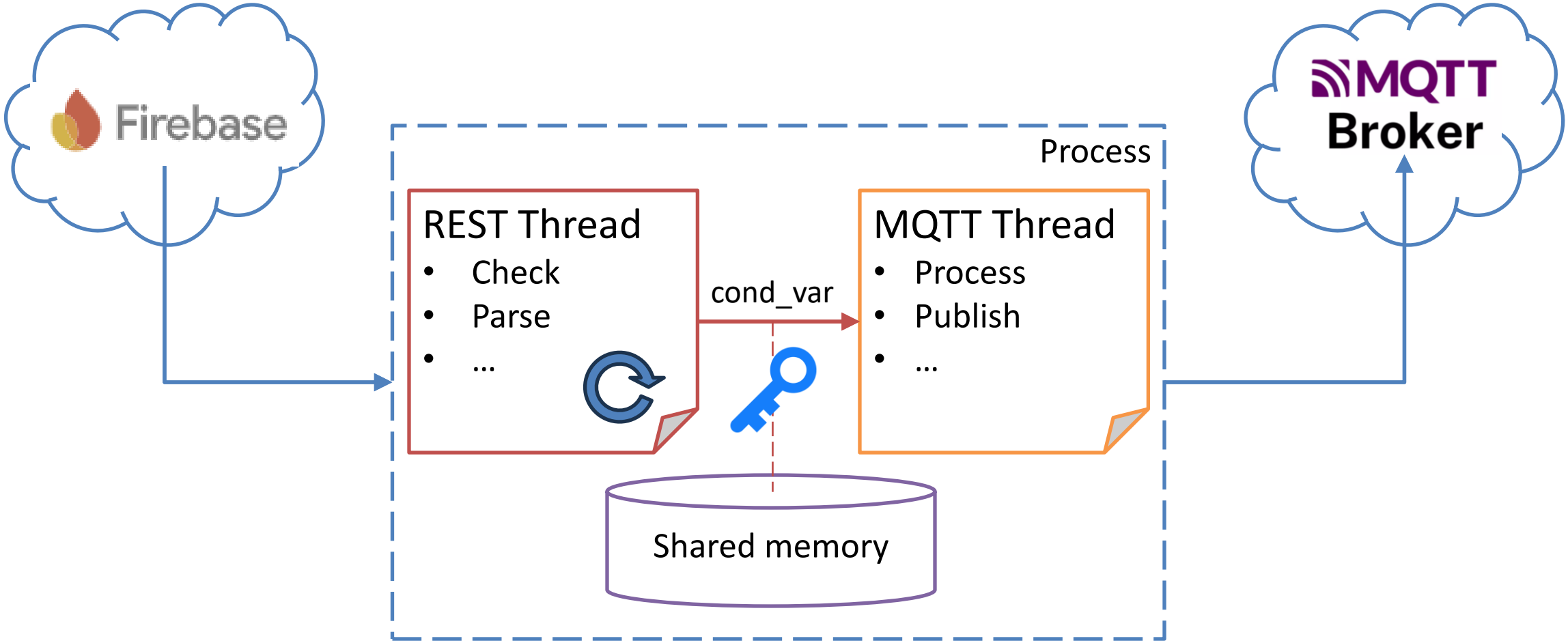
JSON

```
{
"employees":[
    {"firstName":"John", "lastName":"Doe"},
    {"firstName":"Anna", "lastName":"Smith"},
    {"firstName":"Peter", "lastName":"Jones"}
]
}
```

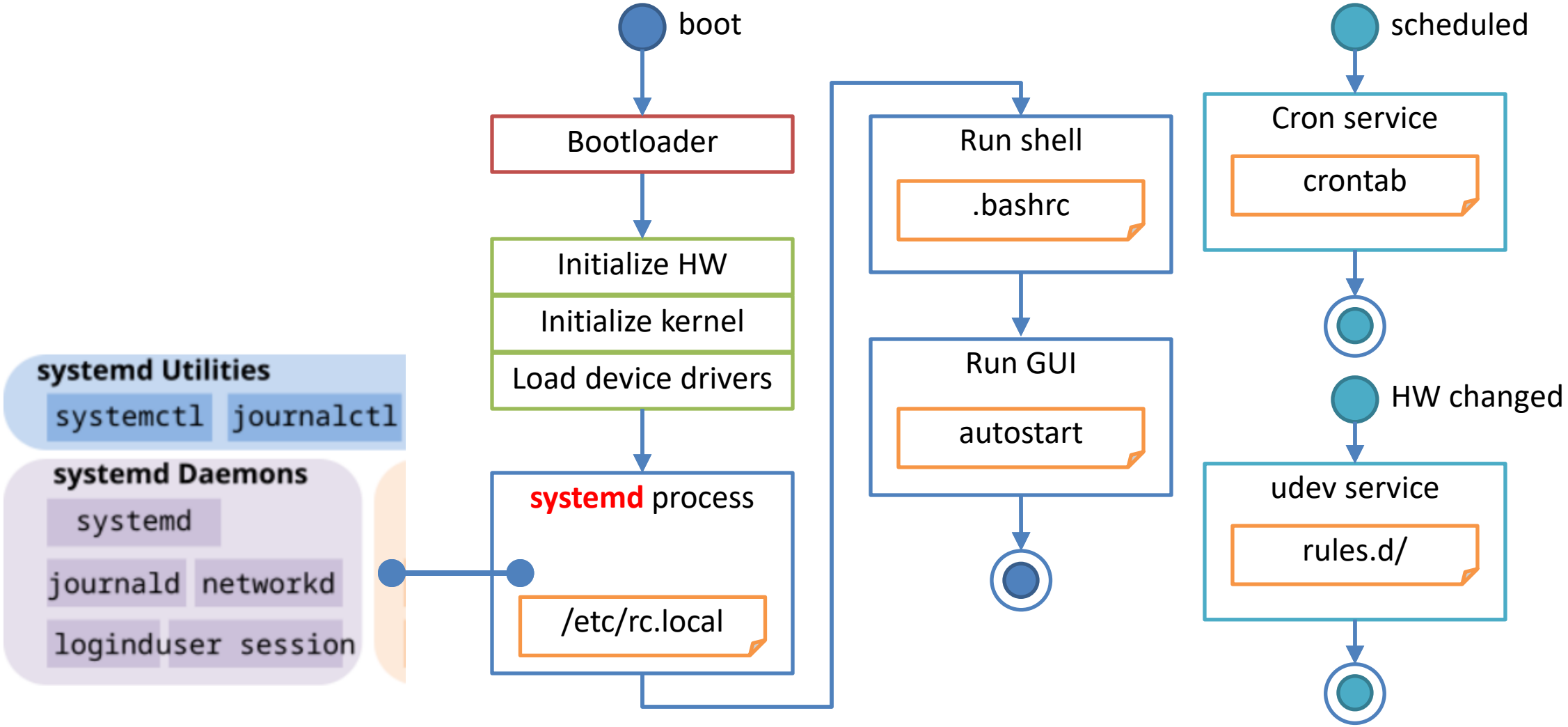
Network programming: Paho MQTT



Practice #4: REST – MQTT endpoint



Automating Linux software



Practice #5: automated RPi device

Run at boot

/etc/rc.local

```
#!/bin/sh -e

_IP=$(hostname -I) || true
if [ "$_IP" ]; then
  printf "IP address is %s\n"
"$_IP"
fi

exit 0
```

Run periodic or one-shot

/etc/crontab

```
# /etc/crontab: system-wide crontab

SHELL=/bin/sh
PATH=/usr/local/sbin

17 *    * * *   root    cd / && run-parts --
report /etc/cron.hourly
47 6    * * 7   root    test -x
/usr/sbin/anacron || { cd / && run-parts --
report /etc/cron.weekly; }
```