Y86 simulator pipeline with Qt

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Authors

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Mainly
design core

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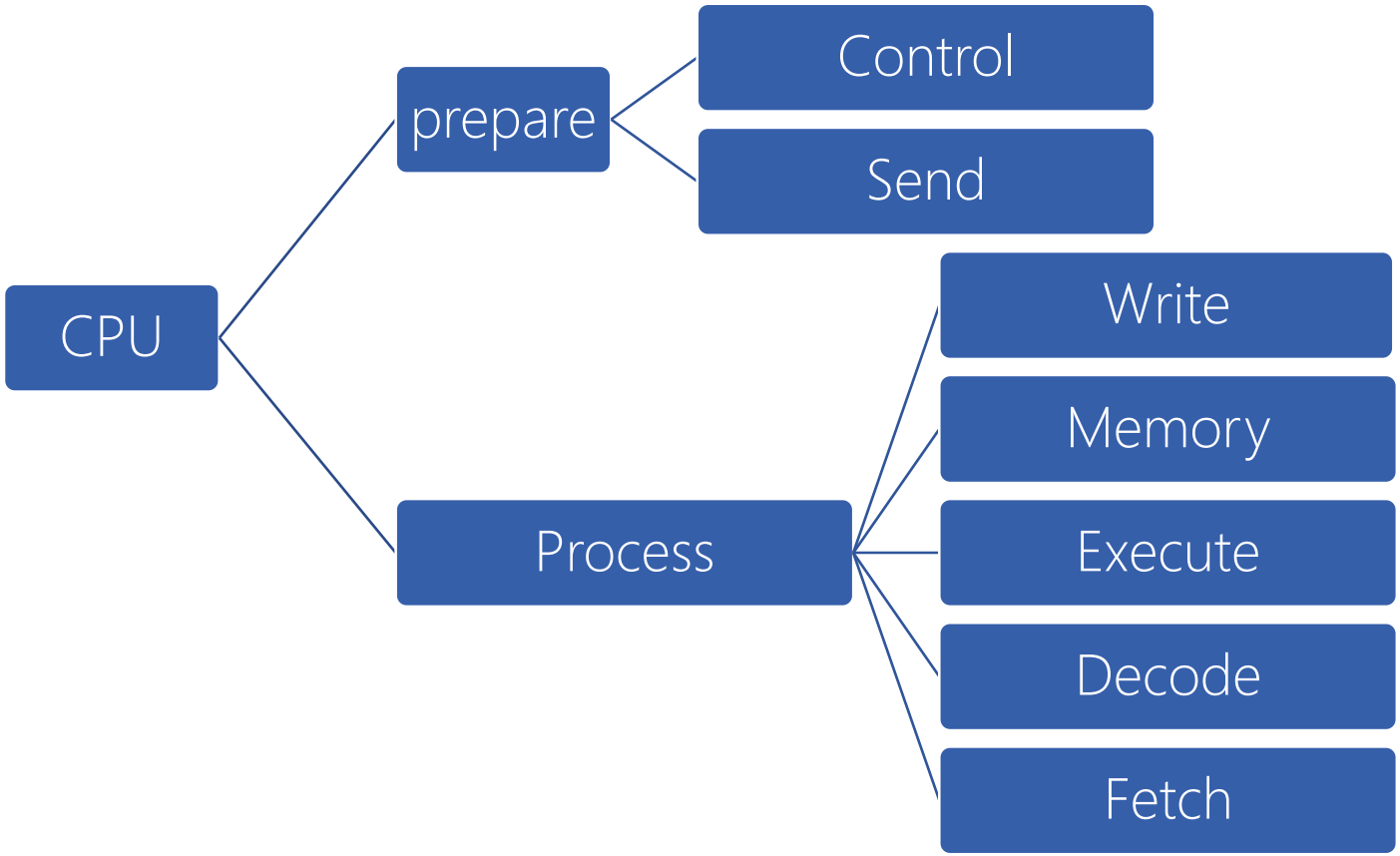
Mainly
design ui

NO.1

内核结构

内核结构


CPU
prepare
Control
Send
Process
Write
Memory
Execute
Decode
Fetch

代码分层图

内核结构

Control

控制暂停与气泡信号

避免流水线冒险

……

Send

控制时钟上升沿的寄存器输入

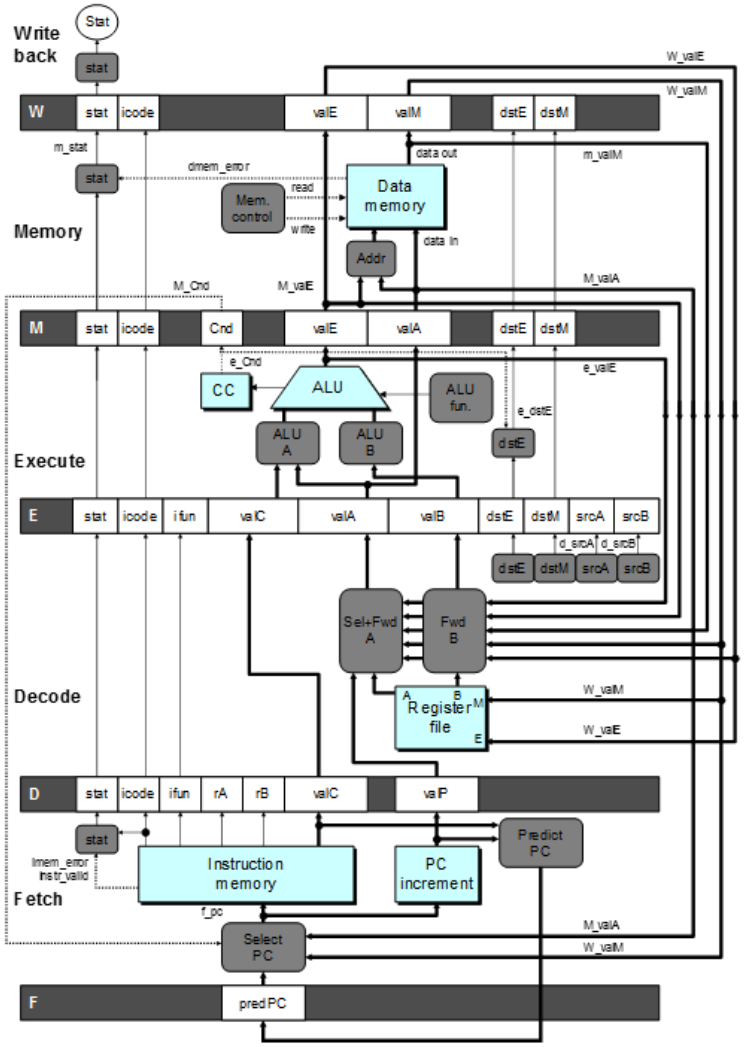
暂停：

- 关闭输入更新

气泡：

- 使用NOP填充
- 原先的输入更新被废弃

内核结构


Write back
Stat
stat
W
stat
icode
valE
valM
dstE
dstM
W_valE
W_valM
m_stat
stat
dmem_error
Memory
Mem. control
read
write
Data memory
data out
data in
m_valM
Addr
M_valA
M_Cnd
M_valE
M
stat
icode
Cnd
valE
valA
dstE
dstM
e_Cnd
e_valE
Execute
CC
ALU
ALU fun.
e_dstE
dstE
ALU A
ALU B
E
stat
icode
ifun
valC
valA
valB
dstE
dstM
srcA
srcB
d_srcA
d_srcB
dstE
dstM
srcA
srcB
Sel+Fwd A
Fwd B
Decode
A
B
Register file
M
E
W_valM
W_valE
D
stat
icode
ifun
rA
rB
valC
valP
stat
Predict PC
imem_error
instr_valid
Instruction memory
PC increment
Fetch
f_pc
M_valA
W_valM
Select PC
F
predPC

流水线图

NO.2

流水线冒险

流水线冒险

Load/use hazards

- Fetch stall
- Decode stall
- Execute bubble

流水线冒险

Load/use hazards

Condition：

(E_icode == IMRMOVL || E_icode == IPOPL)

&&

(E_dstM == d_srcA || E_dstM == d_srcB)

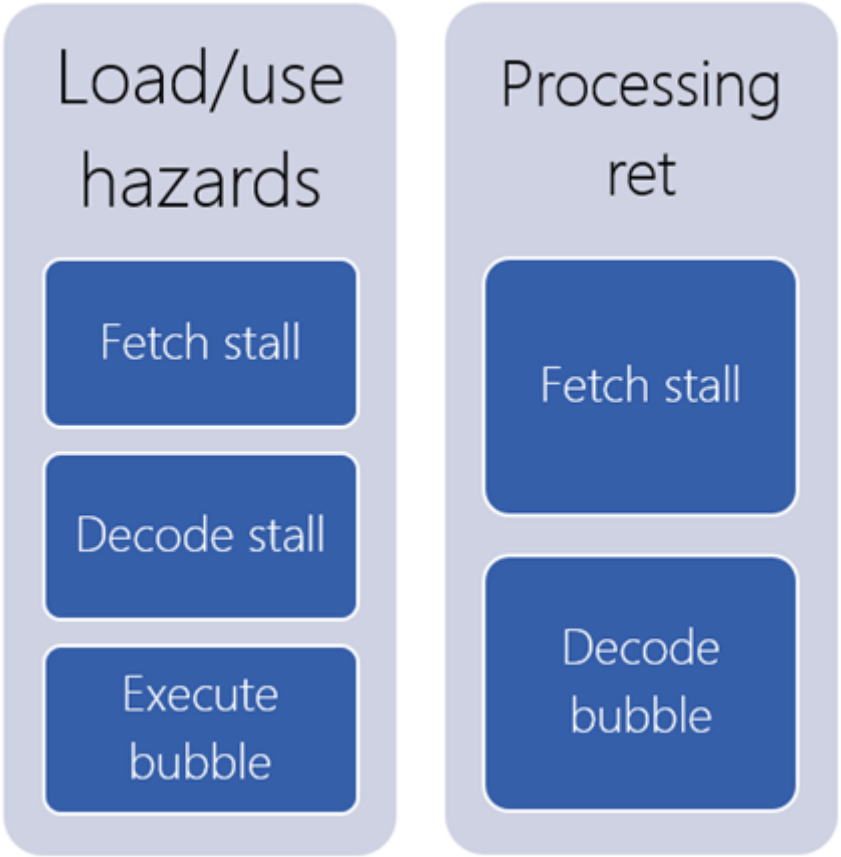
利用bubble & stall机制，在指令A前插入一个nop

Fetch：stall

Decode：stall

Execute：bubble

流水线冒险


Load/use hazards
Fetch stall
Decode stall
Execute bubble
Processing ret
Fetch stall
Decode bubble

分类

流水线冒险

Processing ret

Condition：

D_icode == IRET ||

E_icode == IRET ||

M_icode == IRET

第一次触发：

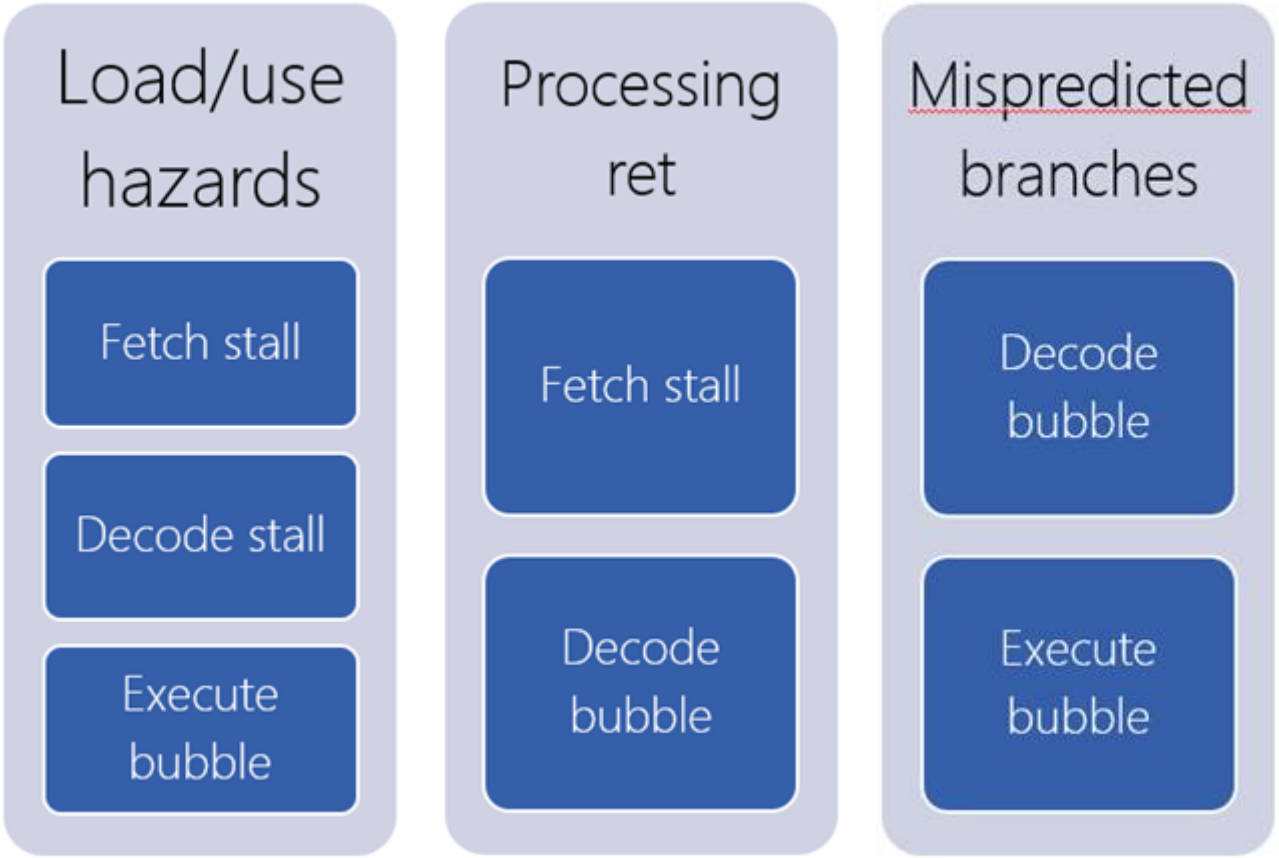
- Decode后的第一个时钟上升沿之前
- 直到ret进入Write-back阶段

Decode：bubble

Fetch：在同一位置取值

- 实质上相当于插入了三个nop语句

流水线冒险


Load/use hazards
Fetch stall
Decode stall
Execute bubble
Processing ret
Fetch stall
Decode bubble
Mispredicted branches
Decode bubble
Execute bubble

分类

流水线冒险

Mispredicted branches

Condition

E_icode == IJXX && !e_Cnd

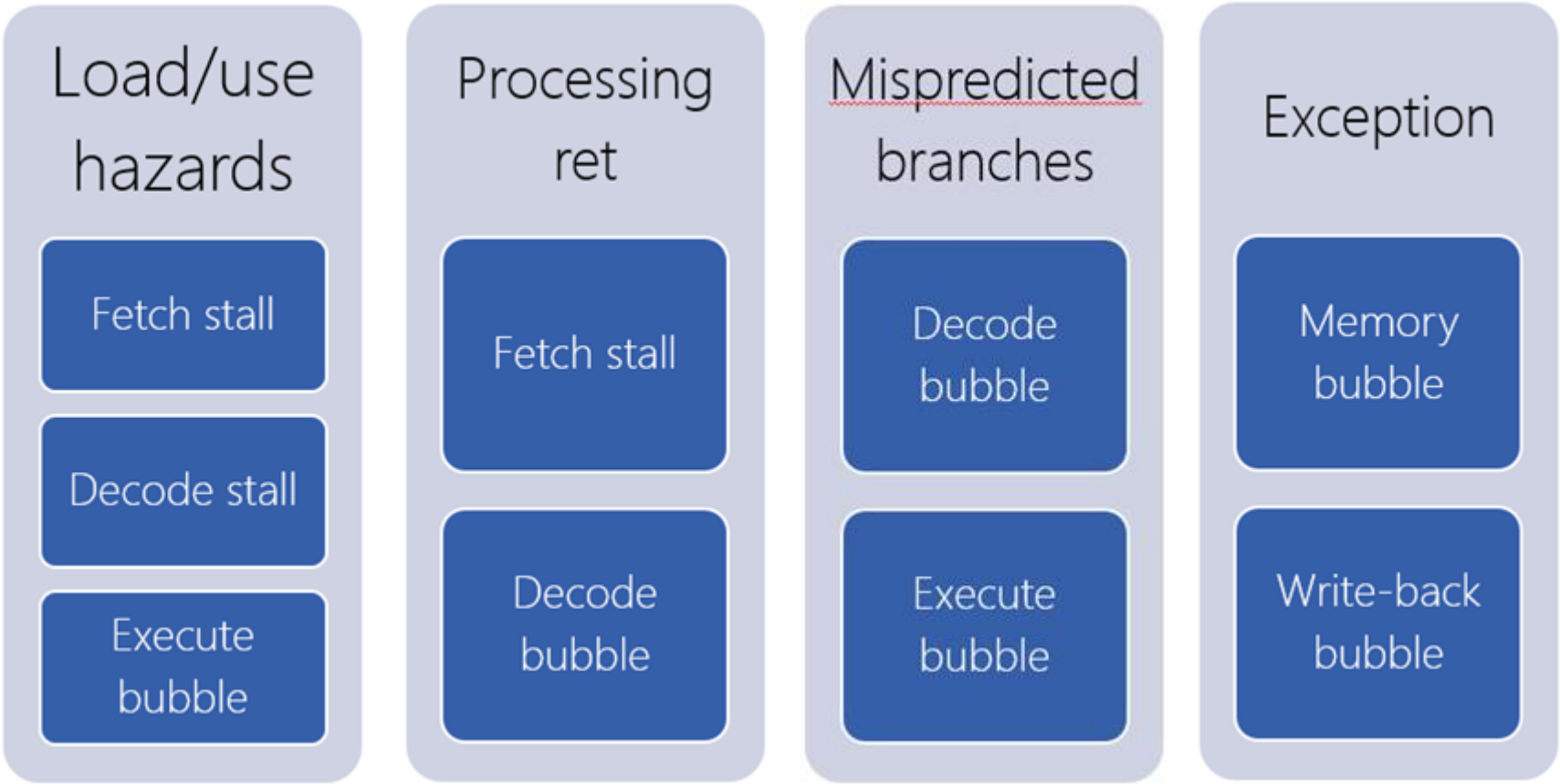
有两个错误的指令进入流水线

- 分别位于Fetch和Decode
- 没有对寄存器、条件码、内存的修改
- 将错误指令抹消即可

Execute：bubble

- 将传入Execute的输入信号抹除
- Decode：bubble 同理、
- Fetch正常执行

流水线冒险


Load/use hazards
Fetch stall
Decode stall
Execute bubble
Processing ret
Fetch stall
Decode bubble
Mispredicted branches
Decode bubble
Execute bubble
Exception
Memory bubble
Write-back bubble

分类

流水线冒险

Exception

Condition：

m_stat == SADR || m_stat == SINS || m_stat == SHLT

W_stat类似

监测到之前执行的指令发生错误

- 需要停止修改
- 类似的在Execute阶段的setConditionCode也有体现

坚持"顺序执行"的原则

- 即使某个指令在Fetch阶段发生错误，也要把之前进入流水线的指令执行完
- （预测错误）

NO.3

优先顺序

If & else

优先顺序

```
void SelFwdA(){
    if (D_icode == ICALL || D_icode == IJXX) d_valA =
    D_valP;
    else if (d_srcA == e_dstE) d_valA = e_valE;
    else if (d_srcA == M_dstM) d_valA = m_valM;
    else if (d_srcA == M_dstE) d_valA = M_valE;
    else if (d_srcA == W_dstM) d_valA = W_valM;
    else if (d_srcA == W_dstE) d_valA = W_valE;
    else d_valA = d_rvalA;
    D_op = D_op + "d_valA <- " + int2str(d_valA) + '\n';
}
```

条件同时满足？？

优先顺序

```
void SelFwdA(){
    if (D_icode == ICALL || D_icode == IJXX) d_valA =
    D_valP;
    else if (d_srcA == e_dstE) d_valA = e_valE;
    else if (d_srcA == M_dstM) d_valA = m_valM;
    else if (d_srcA == M_dstE) d_valA = M_valE;
    else if (d_srcA == W_dstM) d_valA = W_valM;
    else if (d_srcA == W_dstE) d_valA = W_valE;
    else d_valA = d_rvalA;
    D_op = D_op + "d_valA <- " + int2str(d_valA) + '\n';
}
```

顺序执行！

SelFwdA

优先顺序

```
void SelFwdA(){
    if (D_icode == ICALL || D_icode == IJXX) d_valA =
    D_valP;
    else if (d_srcA == e_dstE) d_valA = e_valE;
    else if (d_srcA == M_dstM) d_valA = m_valM;
    else if (d_srcA == M_dstE) d_valA = M_valE;
    else if (d_srcA == W_dstM) d_valA = W_valM;
    else if (d_srcA == W_dstE) d_valA = W_valE;
    else d_valA = d_rvalA;
    D_op = D_op + "d_valA <- " + int2str(d_valA) + '\n';
}
```

还是同时满足？？

优先顺序

```
void SelFwdA(){
    if (D_icode == ICALL || D_icode == IJXX) d_valA =
    D_valP;
    else if (d_srcA == e_dstE) d_valA = e_valE;
    else if (d_srcA == M_dstM) d_valA = m_valM;
    else if (d_srcA == M_dstE) d_valA = M_valE;
    else if (d_srcA == W_dstM) d_valA = W_valM;
    else if (d_srcA == W_dstE) d_valA = W_valE;
    else d_valA = d_rvalA;
    D_op = D_op + "d_valA <- " + int2str(d_valA) + '\n';
}
```

popl %esp !

SelFwdA

NO.4

优先顺序

Processing

优先顺序

- Write-back
- Memory
- Execute
- Decode
- Fetch

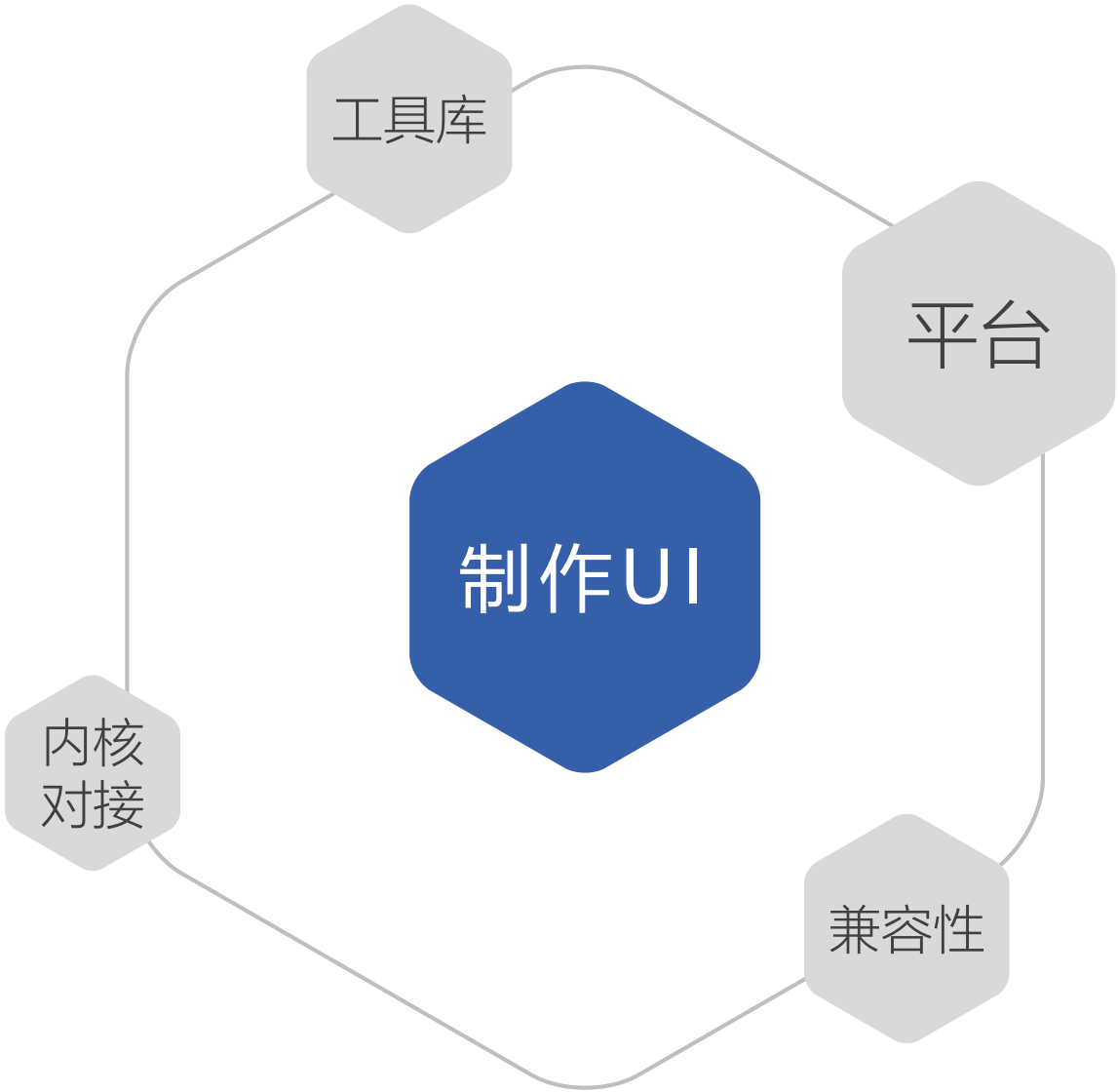
优先顺序

- Write-back
- Memory
- Execute
- Decode
- Fetch
- 照顾转发

NO.5

制作UI

absolute beginner


工具库
平台
制作UI
内核
对接
兼容性

平台和工具库

Why this ?

1、使用Qt Creator和其自带的GUI工具库来实现simulator的UI
2、Qt完全兼容C++，使得内核和UI的对接十分方便。
3、Qt具有良好的跨平台性能，在Windows和Ubuntu下均展现出了良好的兼容性和稳定性
4、Qt的GUI功能十分强大，基础功能就可以满足需要的GUI控件

UI与内核代码的对接

UI与内核代码的对接

Qt本身使用C++实现，同样支持Standard C++的所有功能，可以将编写好的内核作为头文件，轻易调用已经提供的接口，一个编译器可以解决内核和UI的编译

将实现好的内核作为一个类提供给UI部分的代码调用，在适当的时候调用适当的函数即可

Reference

1. https://lug.ustc.edu.cn/sites/qtguide/
2. Help documents in Qt Creator
3. Search Engine and some blogs

NO.6

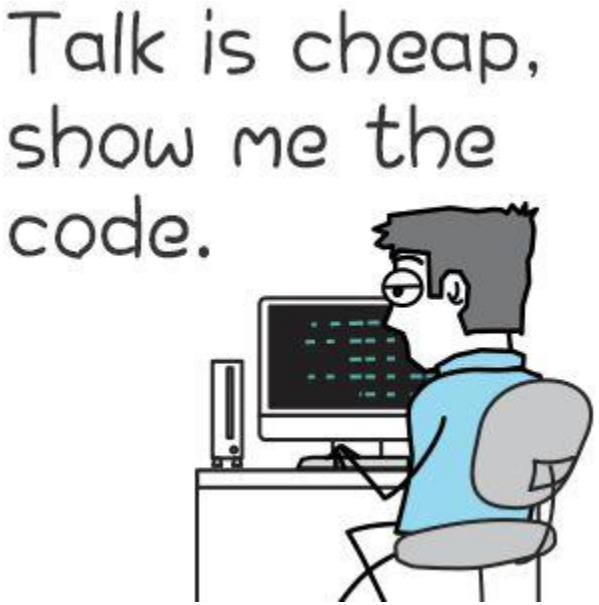
DEMO

UI show

Q & A

Acknowledgement

感谢我们的指导老师金博→



Thanks