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Yinhang Qin
netID: yq2021

Problem 1 The total number of cores are 2.

(i) 1st application:

$$\text{Speedup} = \frac{1}{\frac{40\%}{2} + (1-40\%)} = 1.25$$

2nd application:

$$\text{Speedup} = \frac{1}{\frac{99\%}{2} + (1-99\%)} = 1.98$$

(ii) If 40% of 1st application is parallelized:

Speedup of A is $\frac{1}{\frac{40\%}{2\times 80\%} + (1-40\%)} = 1.1765$

The overall speedup is: $\frac{1}{\frac{80\%}{1.1765} + 20\%} = 1.1364$

If 99% of 2nd application is parallelized:

Speedup of B is: $\frac{1}{\frac{99\%}{2\times 25\%} + (1-99\%)} = 0.4024$

The overall speed up is: $\frac{1}{80\% + \frac{20\%}{0.4024}} = 0.771$

~~= 0.774~~

Problem 2| Assumption:

1. The address of A[0], B[0], C[0] are stored in Register x27, x28, x29
2. The values of variables f, g, i are stored in Register x5, x6, x7

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Yinhong Qin
netID: yq202|

(i)
```
lw x8, 108(x29) //get C[27]
slli x8, x8, 2
add x8, x8, x28
lw x8, 0(x8) //get B[C[27]]
slli x8, x8, 2
add x8, x8, x27
lw x8, 0(x8) //get A[B[C[27]]]
sub x5, x6, x8
```

(ii)
```
lw x30, 40(x29) //get C[10]
lw x31, 44(x28) //get B[11]
add x30, x30, x31 //get C[10]+B[11]
slli x30, x30, 2
add x30, x30, x27
lw x30, 0(x30) //get A[C[10]+B[11]]
sub x5, x6, x30
```

(iii)
```
addi x30, x7, 1 //i+1
slli x30, x30, 7 //32(i+1)=32i+32
                 offset of 32i+32
add x30, x30, x29
lw x30, 0(x30) //get C[32i+32]
slli x31, x30, 1 //2·C[32i+32]
add x30, x30, x31 //3C[32i+32]
addi x8, x7, -1 //i-1
slli x8, x8, 4 //offset of 4i-44
add x8, x8, x28
lw x8, 0(x8) //B[4i-44]
slli x8, x8, 2 //4B[4i-44]
add x8, x8, x30 //4B[4i-44]+3C[32i+32]
slli x26, x7, 2
add x26, x26, x27 //&A[i]
sw x8, 0(x26)
```

Problem 3

Yinhong Qin
net ID: yq202

a. ~~510~~ -8.80158×10^{-2}

$= -0.0880158 = -0.000\,1011\,0100\,0010\,0011$

$= -1.0110\ 1000\ 1000\ 0011 \times 2^{-4}$

The sign-bit is 1.

The exponent part is $7-4=3=0011$

For the fraction part, the round bit = 0, sticky bit = 1

Thus the fraction part is 01101

Therefore, the 10-bit floating format of -8.80158×10^{-2} is

1 0011 0110

The binary format of -0.125 is $-0.001 = 1.0 \times 2^{-3}$

Thus, the sign bit is 1

the exponent part is $7-3=4=0100$

The fraction part is 00000

∴ The 10-bit format of ~~0.07~~ -0.125 is

1 0100 0000

---

0 0101 0001

The sign bit is 0

The exponent part is $1010 = 10 = 0xA$

The fraction part is 0 0001

∴ the base-10 number is

$(-1)^0 \times 2^{10-7} \times (1 + 2^{-2} + 2^{-5}) = 2^3 \times 1.28125$

$= 10.25$

Problem 3

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b. Range of the positive normalized form

The maximum is:
The sign bit is 0,
The exponent part is 1110 = 0xE = 14 (Asume 1111 is assigned to special use)
The fraction part is 11111
∴ The largest number is $(-1)^0 \times 2^{14-7} \times (1+2^{-1}+2^{-2}+2^{-3}+2^{-4}+2^{-5})$
$= 2^7 \times 1.96875 = 252$

The smallest number is:
The sign bit is 0
The exponent part is: 0001 (Assume the 0000 is for special use)
The fraction part is: 0000
∴ The smallest number is: $(-1)^0 \times 2^{1-7} \times (1+0)$
$= 2^{-6} \times 1 = 0.015625 = 1.5625 \times 10^{-2}$

Range of positive denormalized number:

The exponent part is always 0000. For this problem is 1-biased

The largest number:
The sign bit is 0
The fraction part is 11111
∴ The largest number is
$(-1)^0 \times (2^{-1}+2^{-2}+2^{-3}+2^{-4}+2^{-5}) \times 2^{-6}$
$= 0.015136718 75 = 1.513671875 \times 10^{-2}$

The smallest number is
The sign bit is 0
The fraction part is
0000|
∴ The smallest number is
$(-1)^0 \times 2^{-5} \times 2^{-6} = 2^{-11}$
$= 0.000488281 25$
$= 4.88281 25 \times 10^{-4}$

Problem 4

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Yinhong Qin
netID: yq2021

To swapping the contents of x5 and x6 without using other register:

```
add x5, x5, x6  //get  x5' = x5 + x6
sub x6, x5, x6  // let  x6' = x5' - x6 = x5+x6-x6 = x5
sub x5, x5, x6  // finally x5'' = x5' - x6'
                           = x5+x6 - x5 = x6
```

The corresponding C code is:

```
x5 = x5 + x6
x6 = x5 - x6
x5 = x5 - x6
```