

Homework Assignment #10

Note

This assignment is due 2:10PM Wednesday, January 2, 2013. Please write or type your answers on A4 (or similar size) paper. Drop your homework by the due time in Yih-Kuen Tsay's mail box on the first floor of Management College Building 2. Late submission will be penalized by 20% for each working day overdue. You may discuss the problems with others, but copying answers is strictly forbidden.

Problems

1. Consider the following C program fragment.

```
int fac(int n, int res)
{ if (n==0)
    return res;
  else
    return fac(n-1,res*n);
}
```

```
int factorial(int n)
{ return fac(n,1);
}
```

```
main()
{ int k;
  k = factorial(2);
  ...
}
```

- (a) (30 points) Draw a figure showing the contents (including local variables, parameters, control links, the frame pointer, etc.) of the stack right before the last activation of `fac` is about to return.
 - (b) (20 points) Eliminate the tail recursion from `fac` (using the systematic approach discussed in class).
2. (20 points) What is the output of the following program? Please explain.

```
#include <iostream.h>

class B {
public:
virtual char f() { return 'B'; }
  char g() { return 'B'; }
  char testF() { return f(); }
  char testG() { return g(); }
```

```

};

class C : public B {
public:
    char f() { return 'C'; }
    char g() { return 'C'; }
};

main() {
    B b;
    C c;

    cout << c.testF() << c.testG() << b.testF() << b.testG() << "\n";
}

```

3. (30 points) Prove that the following annotated program segment is correct:

```

{ $g = 0 \wedge p = n \wedge n \geq 1$ }
while  $p \geq 2$  do
     $g, p := g + 1, p - 1$ 
od
{ $g = n - 1$ }

```