Real-Time Systems

Exercise #4

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WCET Analysis using Shaw's Method

"The estimated WCET is the execution time of the longest structural path through the program."

The following example is based on Problem 3 in the Exercise Compendium (Collection of Examples).

Example: WCET analysis

Problem: Consider the function `Calculate()`.

a) Using Shaw's method, estimate the WCET for function `Calculate()` in terms of 'Z' (with Z ≥ 0).

```
int Calculate (int Z){
   int R;
   if(Z == 0)
      R = 1;
   else if (Z == 1)
      R = 1;
   else
      R = Calculate(Z-1) + Calculate(Z-2);
   return R;
}
```

Example: WCET analysis

Problem: Consider the function `Calculate()`.

a) Using Shaw's method, estimate the WCET for function `Calculate()` in terms of 'Z' (with $Z \geq 0$).

- Each *declaration* or *assignment* statement costs 1 time unit
- Each *compare* statement costs 1 time unit
- Each *return* statement costs 1 time unit
- Each *addition* or *subtraction* operation costs 4 time units.
- A *function call* costs 2 time units plus WCET for the function in question.
- All other language constructs can be assumed to take 0 time units to execute.

Example: WCET analysis

Problem: Consider the function `Calculate()`.

b) Function `main()` calls function `Calculate()` with parameter 5. What is the WCET of function `main()`?

c) The deadline for executing function `main()` is 180 time units. Determine whether the deadline is met or not.

```
int main(){
    int ans;
    ans = Calculate(5);
}
```

Example: WCET analysis

Problem: Now the program runs on a new processor that has a faster ALU. The execution costs of addition and subtraction are equal, but smaller than that of the older processor.

Let ‘x’ represent the execution time of an addition/subtraction operation. All other language constructs are assumed to have the same cost as in sub-problem a).

d) What is the WCET for function `main()` in terms of ‘x’?

e) What is the maximum cost of an addition/subtraction operation so that the deadline of function `main()` is met?