

**This self-assessment quiz consists of short answer questions totaling 10 marks.**

1. [1 marks] Give the regular expression that you would use with `grep` to find all lines a file that contain the subsequence 3136. E.g. “csci3principles1of3programming3languages” has the subsequence 3136.

`. * 3 . * 1 . * 3 . * 6 . *`

2. [4 marks] Consider the following C struct representing the a node of a singly linked list:

```
struct node {
    struct node *next;
    /* other stuff here */
}
```

Suppose that `head` is a global variable of type `struct node *`, pointing to the head of the linked list. **Write a function in C called `reverse()` that reverses the nodes in the linked list.**

```
void reverse() {
    struct node *tmp;
    struct node *tmp2;

    for( tmp = head; tmp != NULL; ) {
        tmp2 = tmp;
        tmp = tmp->next;
        tmp2->next = head;
        head = tmp2;
    }
}

void reverse() {
    head = helper( head );
}

struct node *helper(struct node *n) {
    if( n != NULL ) {
        n->next = helper( n->next );
    }
    return n;
}
```

3. [5 marks] Prove using induction that  $\sum_{i=0}^n 2^i = 2^{n+1} - 1$ .

Proof by induction on  $n$ .

**Base case**  $n = 0$ :  $\sum_{i=0}^0 2^i = 2^0 = 1 = 2 - 1 = 2^1 - 1 = 2^{0+1} - 1$ .

**Inductive Hypothesis:** Assume that for some  $n_0 > 0$ ,  $\forall n < n_0$ ,  $\sum_{i=0}^n 2^i = 2^{n+1} - 1$ .

**Inductive Step:** Prove that the inductive hypothesis holds for  $n = n_0$ . Observe that

$$\sum_{i=0}^n 2^i = 2^n + \sum_{i=0}^{n-1} 2^i$$

By our inductive hypothesis  $\sum_{i=0}^{n-1} 2^i = 2^n - 1$ . Consequently,

$$\sum_{i=0}^n 2^i = 2^n + \sum_{i=0}^{n-1} 2^i = 2^n + 2^n - 1 = 2^{n+1} - 1$$