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CS 3141: Prof. Kamil's Algorithm Analysis
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# Homework in Org-mode

**Question 1.** What is this document?

This is a demonstration of my homework LaTeX class. It is an extension of the `amsart` and should have all of its functionality. These are some of the set symbols: $\mathbb{C} \supset \mathbb{R} \supset \mathbb{Q} \supset \mathbb{Z} \supset \mathbb{N}$, then some Greek and other mathematical symbols are, $\alpha, \varepsilon, \partial, \to, \Rightarrow, \hookrightarrow, \twoheadrightarrow, \rightarrowtail$. We can also insert multiple figures as seen in figure 1. There is also an `org-mode` version of this file[1].


FIGURE 1. Al'Khwarizmi

**Question 2.** Prove that $\exists (x, y) \in \mathbb{Z}$ such that $x + y = 4$.

We show,

*Proof of important theorem.* Four is the sum of two integers.

$1, 3 \in \mathbb{Z}$ and $1 + 3 = 4$. *QED.*

**Question 3.** What is the cardinality of Natural Numbers?

It is $\aleph_0$ [1]. See also question 99.

**Question 99.** Is the cardinality of Naturals and Reals the same because they are both infinite?

No, the cardinality of Reals is greater because they are also un-listable (uncountable). See also question 3.

**Question 4.** Finally the numbered bullets are done with the `enumitem` package,

1) With just bullets,
   - **Cats**
   - *Dogs*

**Question (Bonus) 1.** State chain rule.

Chain Rule:

$$\zeta(x) = f(g(x)) \quad \text{then according to the chain rule:} \quad \frac{\mathrm{d}\,\zeta}{\mathrm{d}\,x} = \frac{\mathrm{d}\,f}{\mathrm{d}\,g} \times \frac{\mathrm{d}\,g}{\mathrm{d}\,x}$$

**Question (Bonus) 2.** Euclidean Algorithm

You may write code as in listing 1,

[1] Tashfeen's `org-mode` configurations can be found here.

```python
def gcd(x, y):  # x > y
  x0, x1, y0, y1 = 1, 0, 0, 1
  while (y > 0):
    print('\\gcd(%d, %def) &: %d &&= ' % (x, y, x), end='')
    q, r = divmod(x, y)
    # print('%d \\times %d + %d &&\\quad' % (q, y, r), end='')
    # print('[%d, %d] - %d[%d, %d] = ' % (x0, x1, q, y0, y1), end='')
    x, y = y, r
    x0, x1, y0, y1 = y0, y1, x0 - q * y0, x1 - q * y1
    # print('[%d, %d] \\\\' % (y0, y1))
  return x, x0, x1
```

Listing 1. Euclidean Algorithm for Greatest Common Factor

**Question 5.** How do we insert in-file code?
Like in listing 2,

```python
def fib(n):
  if n == 0: return 0
  if n == 1: return 1
  return fib(n - 1) + fib(n - 2)
print(fib(20))
```

Listing 2. Recursive Python function to calculate $n^{th}$ Fibonacci number.

## References

[1] Sandra Lach Arlinghaus and SL Arlinghaus. Part ii. elements of spatial planning: Theory. merging maps: Node labeling strategies. *Unknown*, 1996.

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