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CS 3141: Prof. Kamil's Algorithm Analysis
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Homework Class Test

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, $\alpha, \varepsilon, \partial, \to, \Rightarrow, \hookrightarrow, \twoheadrightarrow, \hookrightarrow$. We can also insert multiple figures as seen in figure 1. There is also an `org-mode` version of this file [1].

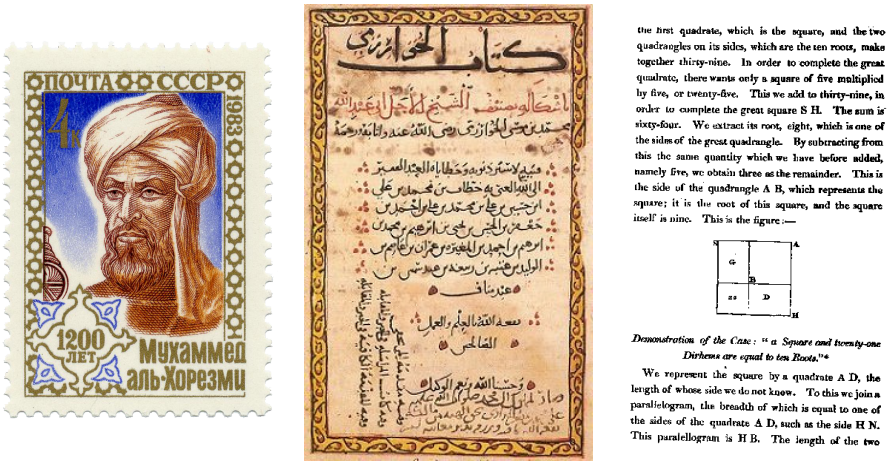

FIGURE 1. Al'Khwarizmi

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

Proof. 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*

Bonus Question 1. State chain rule.

Chain Rule:

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

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

Bonus Question 2. Euclidean Algorithm

You may write code as in listing 1,

```
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

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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