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

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 1. 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.*

Bonus Question 1. Bonus Question Statement

Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

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

Bonus Question 2. Euclidean Algorithm
You may write code,

```
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)
```

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

```
    # 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

Question 2. What is the cardinality of Natural Numbers?
It is $\aleph_0$ [1].

Question 3. 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).

Question 99. Custom Numbering.
This question is numbered 99.

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

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

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

```
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. 1996.

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