Sample Homework in LaTeX

Kurt Schmidt

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Problem 1

Description of the problem.

Note, I changed Solution to an environment, so you can modify the attributes of text in a solution separately.

Solution

This is a simple paragraph.

Two linefeeds in a row make a new paragraph. We can inline math: Let $f_n = 3n^2 + 2n - 17$

We can put math in its own block:

$$\begin{aligned} \text{Let } n = 5. \text{ Substituting:} \\ f(5) = 3(5)^2 + 2(5) - 17 \\ f(5) = 3 * 25 + 10 - 17 \\ \text{So, of course:} \\ f(5) = 68 \end{aligned}$$

We can get the equals signs to line up:

$$\begin{aligned} \text{Let } n = 5. \text{ Substituting:} \\ f(5) &= 3(5)^2 + 2(5) - 17 \\ &= 3 * 25 + 10 - 17 \\ \text{And, here's text:} \\ f(5) &= 68 \end{aligned}$$

The **align** environment from **amsmath** is, apparently, preferred to **eqnarray**, which seems to be buggy. Read this discussion from someone much better than I at LaTeX.

The **split** environment allows for slightly nice continued lines, I believe, w/appropriate numbering. Also, note the **operatorname** command for log-like operators which aren't already defined.

$$f_i(x) = i^2 \,\text{This}\, x + i \,\text{is\_a\_really}\, x + \text{long\_line}\, x \tag{1}$$

$$g_i(x) = i \,\text{not\_as\_long}\, x \tag{2}$$

Problem 2

Part a

Here are some sums you'd better have stuck in your head

Solution

Standard identities:

$$\sum_{i=a}^{b} r = (b - a + 1)r \tag{3}$$

$$\sum_i c(f_i) = c\sum_i (f_i) \tag{4}$$

(And we have big brackets):

$$\sum_i (f_i + g_i) = \left(\sum_i f_i + \sum_i g_i\right) \tag{5}$$

Closed forms for some common sums:

$$\sum_{i=1}^{m} i = \frac{m(m+1)}{2} \tag{6}$$

$$\sum_{i=1}^{m} i^2 = \frac{m(m+1)(2m+1)}{6} \tag{7}$$

$$\sum_{i=0}^{m} ar^i = a\frac{r^{m+1} - 1}{r - 1}\,, r \neq 1 \tag{8}$$

$$\sum_{i=0}^{\infty} ar^i = \frac{a}{1 - r}\,, 0 < |r| < 1 \tag{9}$$

Part b

Here are some logs you'd better have stuck in your head

Solution

$$\log_b 1 = 0 \tag{10}$$

$$\log_b b = 1 \tag{11}$$
$$\log_b(xy) = \log_b x + \log_b y \tag{12}$$
$$\log_b \frac{x}{y} = \log_b x - \log_b y \tag{13}$$
$$\log_b x^n = n \log_b x \tag{14}$$
$$\log_b x = \frac{\ln x}{\ln b} \tag{15}$$

Problem 3

Here's a definition of Fibonacci numbers

Solution

$$F_n = \begin{cases} F_{n-1} + F_{n-2} & \text{if } n > 1 \\ 1 & \text{if } n \in \{0, 1\} \end{cases}$$

Problem 4

And tables are pretty easy. & separates columns, and \\ is a newline in LaTeX

Solution

Name	n	$(3/2)^n$
Picard	0	1
Riker	1	1.5
Worf	2	2.25
Troi	3	3.375
Crusher	4	5.0625
LaForge	5	7.59375
O'Brien	6	11.390625
Guinan	7	17.0859375
Q	8	25.62890625

We can get the decimals to line up:

Name	n	$(3/2)^n$.
Picard	0	1.
Riker	1	1.5
Worf	2	2.25
Troi	3	3.375
Crusher	4	5.0625
LaForge	5	7.59375
O'Brien	6	11.390625
Guinan	7	17.0859375
Q	8	25.62890625

Problem 5

Show the following statements:

Part a

$3n + 7 \in \mathrm{O}(n^2)$

Solution

By the definition, we need to find a $c > 0$ and $n_0 > 0$ such that $cn^2 \geq 3n + 7, \forall n > n_0$:

$$\begin{array}{lll} 3n + 7 & \leq 3n^2 + 7n^2 & ,\forall n \geq 1 \\ & = 10n^2 & \\ \text{So, we have} & & \\ 10n^2 & \geq 3n + 7 & ,\forall n > 1 \end{array}$$

We have our 2 witnesses. $c = 10, n_0 = 1$

Problem 6

Write some nonsense code, by way of example.

Solution

Here's a list of common math symbols in $LaTeX$: `https://oeis.org/wiki/List_of_LaTeX_mathematical_symbols`

Algorithm 0.1 Totally optional

```
function FOO(G: graph, c: color)
    S ← SET()
    rv ← 13
                                          ▷ This is a comment – O(V^2)
    for all v ∈ G do
        color[v] ← white
    end for
    BAR(Q, c)

    while not ISEMPTY(S) and MAGIC(v) do
        if x ≤ ∞ then
            π[w] ← v
            INSERT( S, v )
        else
            π[w] ← u
        end if
        JUGGLE_MAGIC()
    end while
return S
end function

for i ← 1..n do
    for j ← 1..i do
        PRINT( i, j )
    end for
end for
```