# **Sequences**

October 5, 2010

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- Sequences do not necessarily start with  $a_1$ . They may start with any other number.
- A sequence may be finite or infinite.

There are three common ways to describe sequences:

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  - $2, 4, 7, 11, 15, \ldots, \binom{n+1}{2} \ldots$
  - **3** 0, 3, 8, 15, . . .

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  - $2,3,5,6,7,8,10,11,12,13,14,15,17,\ldots a_n =?$

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    - Answer:  $a_n$  is "The  $n^{th}$  non perfect square."

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  - $\mathbf{0} \ 1, 2, 3, 5, 8, \dots, \quad a_{n+2} = a_{n+1} + a_n$



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- Recursively
  - $1,2,3,5,8,\ldots, \quad a_{n+2}=a_{n+1}+a_n$
  - $a_{n,k} = a_{n-1,k-1} + a_{n-k,k}, \quad a_{n,0} = 0, a_{n,n} = a_{n,1} = 1 \ n \ge k$



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  - **1** 1, 2, 3, 5, 8, ...,  $a_{n+2} = a_{n+1} + a_n$
  - $a_{n,k} = a_{n-1,k-1} + a_{n-k,k}, \quad a_{n,0} = 0, a_{n,n} = a_{n,1} = 1 \ n \ge k$
  - $a_n = (n-1)(a_{n-1} + a_{n-2}), \quad a_1 = 0, a_2 = 1.$



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- There are many other "named sequences". We shall study some of them.
- We shall start by examining a number of examples.



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- $3, 6, 11, 18, 27, 38, 51, \dots a_n = ?$

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#### Remark

Consider the last example. It was not too difficult to see that  $a_n = 3^n - 2^n$ 



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- $\mathbf{0}$  1, 2, 4, 8, 14, 25, 45, 79, 138, 240, . . .  $a_n = ?$
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