

# **Discrete Mathematics**

## **Induction and Recursion**

Pangyen Weng, Ph.D  
Metropolitan State University

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# Summations

## The Summation Notation

Summation notations are used to denote sums of consecutive terms in a sequence.

$$\sum_{i=s}^t a_i = a_s + a_{s+1} + \cdots + a_t$$

$\sum_{i=s}^t a_i$ : **summation form**;  $a_s + a_{s+1} + \cdots + a_t$ : **expanded form**.

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## Examples.

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## Examples.

1. Find the summation form for  $a_4 + a_5 + \cdots + a_{20}$
2. Find the expanded for

$$\sum_{i=5}^{48} b_i$$

## Evaluating Summations

Sometimes the terms  $a_i$  is expressed as a function of  $i$ .

**Examples.** Expand and evaluate the following.

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**Examples.** Expand and evaluate the following.

1.  $\sum_{i=1}^5 i^3$

2.  $\sum_{j=2}^7 2^j$

## Separating the Last Term

$$\sum_{i=m}^k a_i = a_k + \sum_{i=m}^{k-1} a_i$$



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$$\sum_{i=m}^k a_i = a_k + \sum_{i=m}^{k-1} a_i$$

**Examples.** Separate the last term for the following.

$$\sum_{i=0}^{10} 2^i =$$

$$\sum_{i=1}^{k+1} i^3 =$$