

# Introduction

## Abstract

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# Contents

<b>1</b>	<b>Introduction to Cancer</b>	<b>3</b>
1.1	what is cancer?	3
1.1.1	Cells proliferating	3
1.1.2	DNA messed up	3
1.1.3	variety of cancer	3
1.1.4	some safe	3
1.1.5	some not safe	3
1.2	who is concerned?	3
1.3	risk factors	3
1.3.1	environment impacts the probability of getting cancer	3
1.3.2	living habits as well	3
1.3.3	genetic impacts as well (e.g. "cancer gene")	4
1.4	possible treatments	4
1.4.1	surgery	4
1.4.2	RT	4
1.4.3	chemotherapy	4
1.4.4	combination	4
1.5	10 cancer markers	4
1.5.1	cell proliferation	4
1.5.2	reprogram cellular metabolism	4
1.5.3	stop cell growth arrest	4
1.5.4	evade apoptosis	4
1.5.5	escape immune system	4
1.5.6	ability to undergo a sufficient number of successive cell cycles of growth and division to generate macroscopic tumors	4
1.5.7	create new blood vessels to get nutrients	4
1.5.8	allow cell escape and metastasis formation	4
1.5.9	change cellular response phenotypic via plasticity	4
1.5.10	senescence	4
1.5.11	cancer can be considered as a living thing on its own	4
1.5.12	beyond the cellular level, impacting tissues	4
1.6	4 cancer conditions	4
1.6.1	mutation	4
1.6.2	epigenetic reprogramming	4
1.6.3	inflammatory context	4
1.6.4	disruption of microbiota	4
1.7	phases of cancer	4
1.7.1	initiation	4
1.7.2	promotion	4
1.7.3	tumorigenesis + neoangiogenesis	4
1.7.4	evolution (local, regional, metastasis)	4
1.8	cancer classification:	4
1.8.1	tumor, node, metastasis	4

1.8.2	stages classification: . . . . .	4
1.9	cancer causes . . . . .	5
1.10	personalized treatments . . . . .	5
1.10.1	revolution . . . . .	5
1.10.2	rapid advances . . . . .	5
1.10.3	help of mathematics . . . . .	5
1.10.4	help of AI . . . . .	5
<b>2</b>	<b>Introduction to Mathematical Optimization</b>	<b>5</b>
<b>3</b>	<b>Introduction to Artificial Intelligence</b>	<b>6</b>

# **1 Introduction to Cancer**

## **1.1 what is cancer?**

### **1.1.1 Cells proliferating**

### **1.1.2 DNA messed up**

### **1.1.3 variety of cancer**

### **1.1.4 some safe**

(e.g.: mole/freckle)

### **1.1.5 some not safe**

worse make the human die

## **1.2 who is concerned?**

more and more ppl

## **1.3 risk factors**

### **1.3.1 environment impacts the probability of getting cancer**

(e.g.: UV exposure)

### **1.3.2 living habits as well**

(e.g.: smooking)

- 1.3.3 genetic impacts as well (e.g. "cancer gene")
- 1.4 possible treatments
  - 1.4.1 surgery
  - 1.4.2 RT
  - 1.4.3 chemotherapy
  - 1.4.4 combination
- 1.5 10 cancer markers
  - 1.5.1 cell proliferation
  - 1.5.2 reprogram cellular metabolism
  - 1.5.3 stop cell growth arrest
  - 1.5.4 evade apoptosis
  - 1.5.5 escape immune system
  - 1.5.6 ability to undergo a sufficient number of successive cell cycles of growth and division to generate macroscopic tumors
  - 1.5.7 create new blood vessels to get nutrients
  - 1.5.8 allow cell escape and metastasis formation
  - 1.5.9 change cellular response phenotypic via plasticity
  - 1.5.10 senescence
  - 1.5.11 cancer can be considered as a living thing on its own
  - 1.5.12 beyond the cellular level, impacting tissues
- 1.6 4 cancer conditions
  - 1.6.1 mutation
  - 1.6.2 epigenetic reprogramming
  - 1.6.3 inflammatory context
  - 1.6.4 disruption of microbiota
- 1.7 phases of cancer
  - 1.7.1 initiation
  - 1.7.2 promotion
  - 1.7.3 tumorigenesis + neoangiogenesis
  - 1.7.4 evolution (local, regional, metastasis)
- 1.8 cancer classification:
  - 1.8.1 tumor, node, metastasis
  - 1.8.2 stages classification:
    - stage 0 which corresponds to a so-called in situ tumor

stage 1 which corresponds to a single, small tumor

stage 2 which corresponds to a larger local volume

stage 3 which corresponds to invasion of the lymph nodes or surrounding tissues

stage 4 which corresponds to a wider extension in the body in the form of metastases

## 1.9 cancer causes

various reasons why

environment

inherited mutations

mistake in DNA copy

## 1.10 personalized treatments

1.10.1 revolution

1.10.2 rapid advances

1.10.3 help of mathematics

1.10.4 help of AI

# 2 Introduction to Mathematical Optimization

- \* optimization def: selection of a best element, with regard to some criteria

- \* in math: more precisely: optimization problem consists of maximizing or minimizing a real function by systematically choosing input

- \* notion of allowed set

- \* discrete vs continuous optim

- \* many real-world and theoretical problems may be modeled in continuous general framework.

- \*  $\max(f) \Leftrightarrow \min(-f)$  hence only min

- \* notion of local vs global min

- \* feasibility

- \* existence

- \* optim algos

- \* 1st order

- \* gradient descent

- \* line search

- \* quasi-newton methods

- \* 2nd order

- \* newton's method

- \* 0th order
- \* brute force
- \* heuristics
  - \* least squares
  - \* multi-objective optimization

### 3 Introduction to Artificial Intelligence

- \* quick def
  - \* general idea
  - \* common architectures
- \* FC
- \* MLP
- \* CNN
- \* RNN
- \* transformers
  - \* Machine learning vs Artificial Intelligence vs Deep Learning
  - \* applications
  - \* learning types
- \* supervised
- \* un-supervised
- \* self-supervised
- \* reinforcement / semi-supervised
  - \* tasks
- \* classical tasks
- \* regression
- \* classification
- \* partitioning
- \* dimension reduction
- \* generative AI
- \* images => training is difficult
- \* text
  - \* recent progress
- \* computer vision
- \* playing games (a way to assess intelligence)
- \* image generation
- \* text generation