

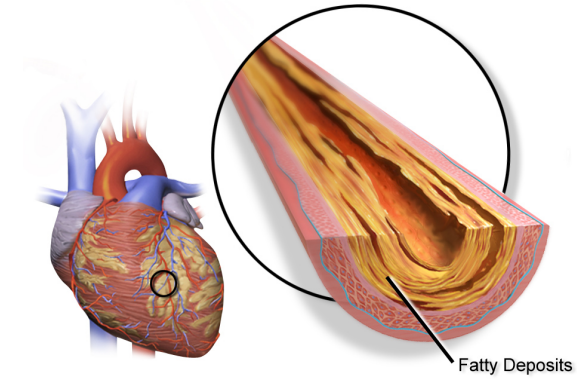
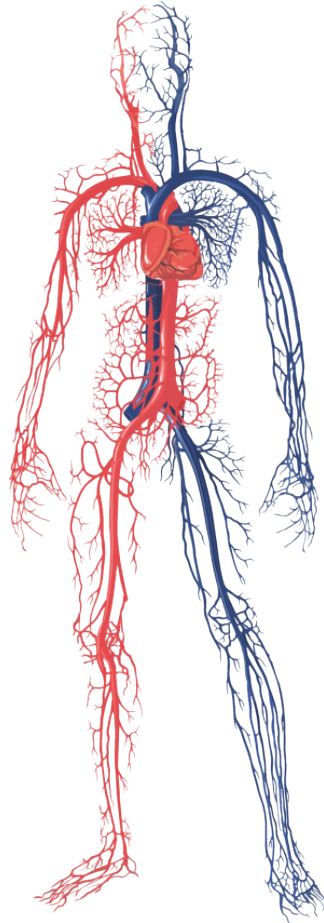
Analysis of retina images

Solving biological problems that require math 2022

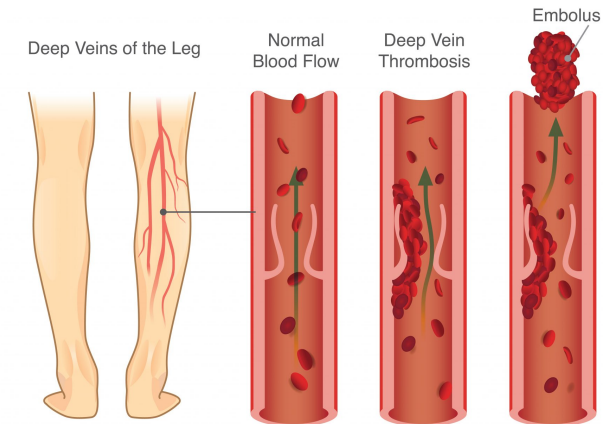
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The cardiovascular system and disease



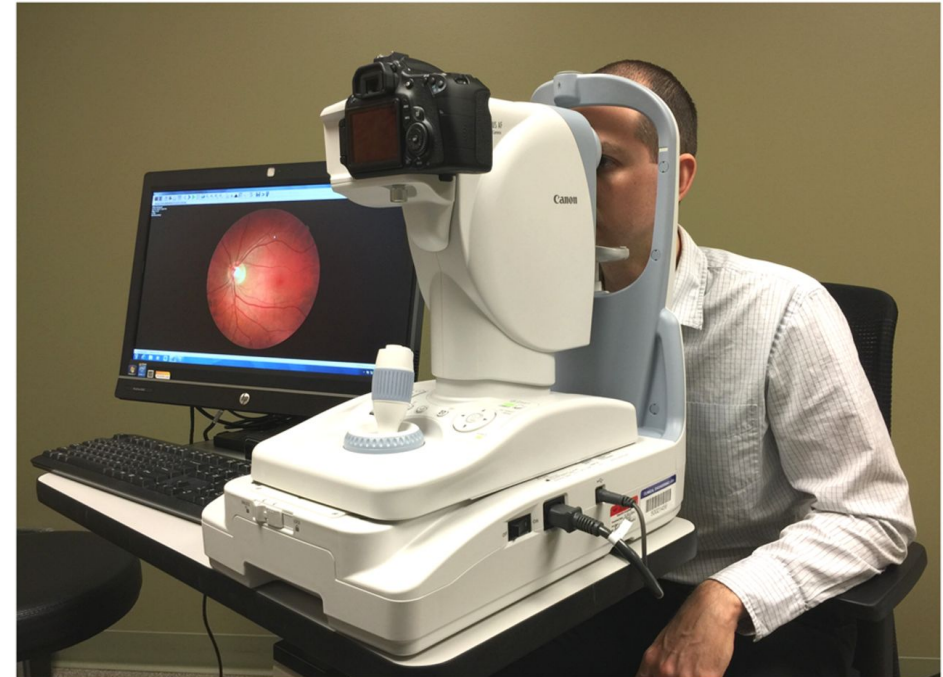
Deep Vein Thrombosis (DTV)



How can we visualize the vascular system?

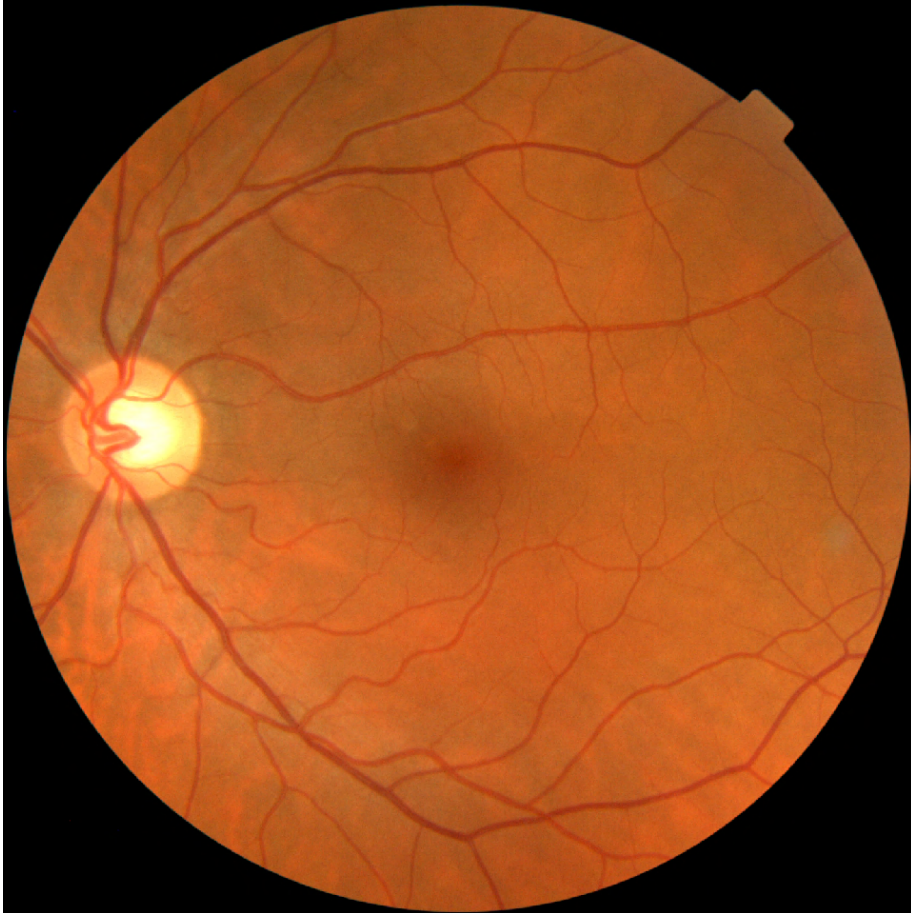


X-ray coronary angiogram



funduscopy

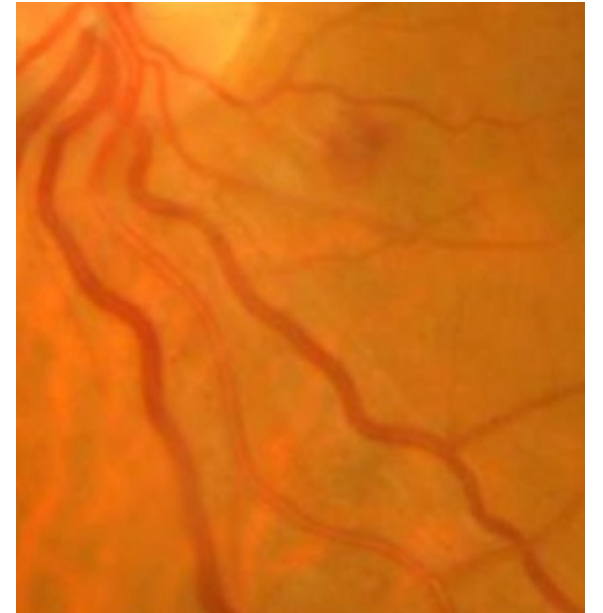
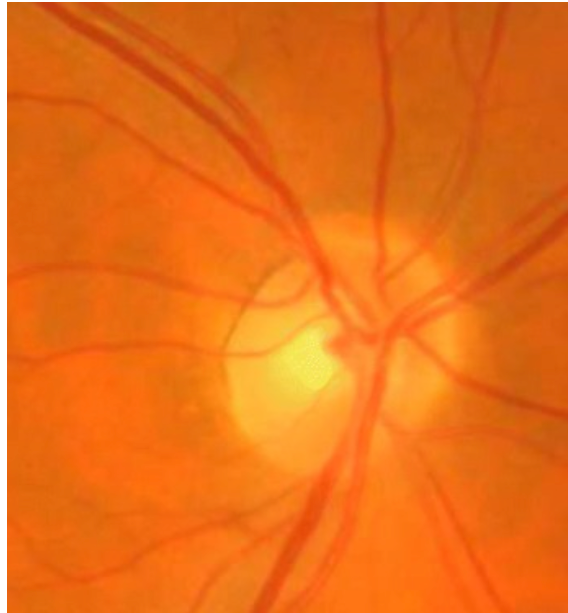
The fundus is being extensively studied



N > 85'000 !

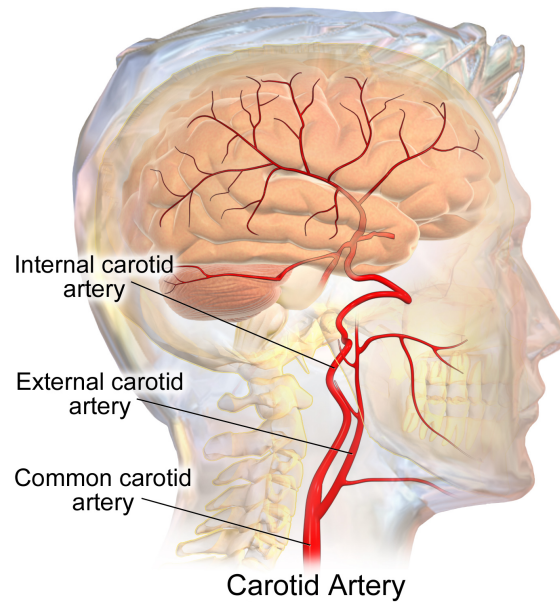
Disease-relevant markers in retinal vasculature

Tortuosity

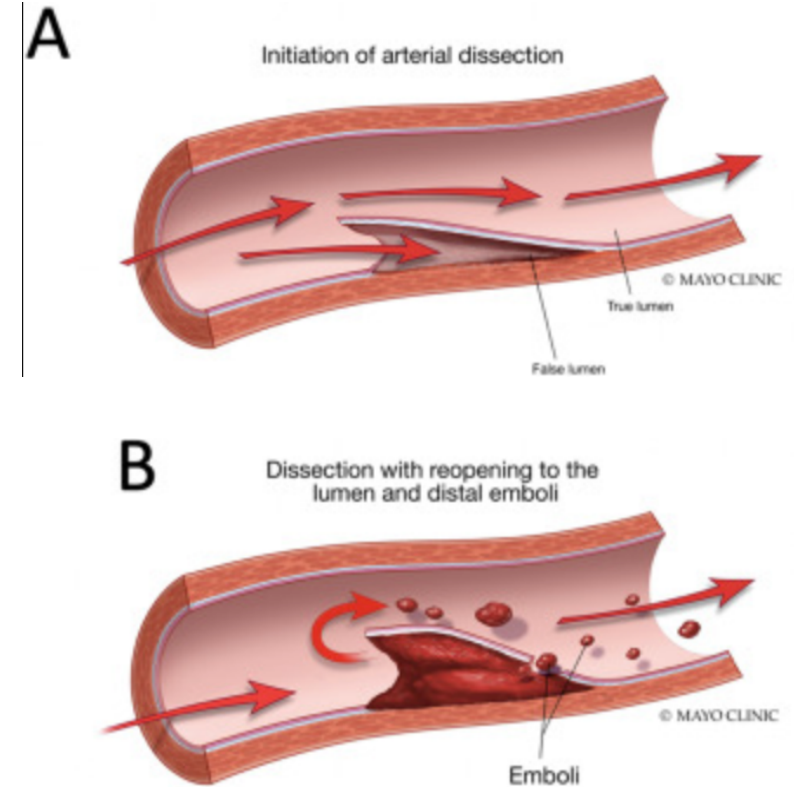


Tortuosity in other tissues is risk factor for dissection

Bum Joon Kim et al., 2016
Sarasa T. Kim et al., 2018

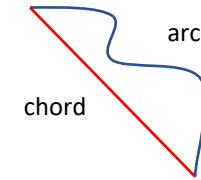
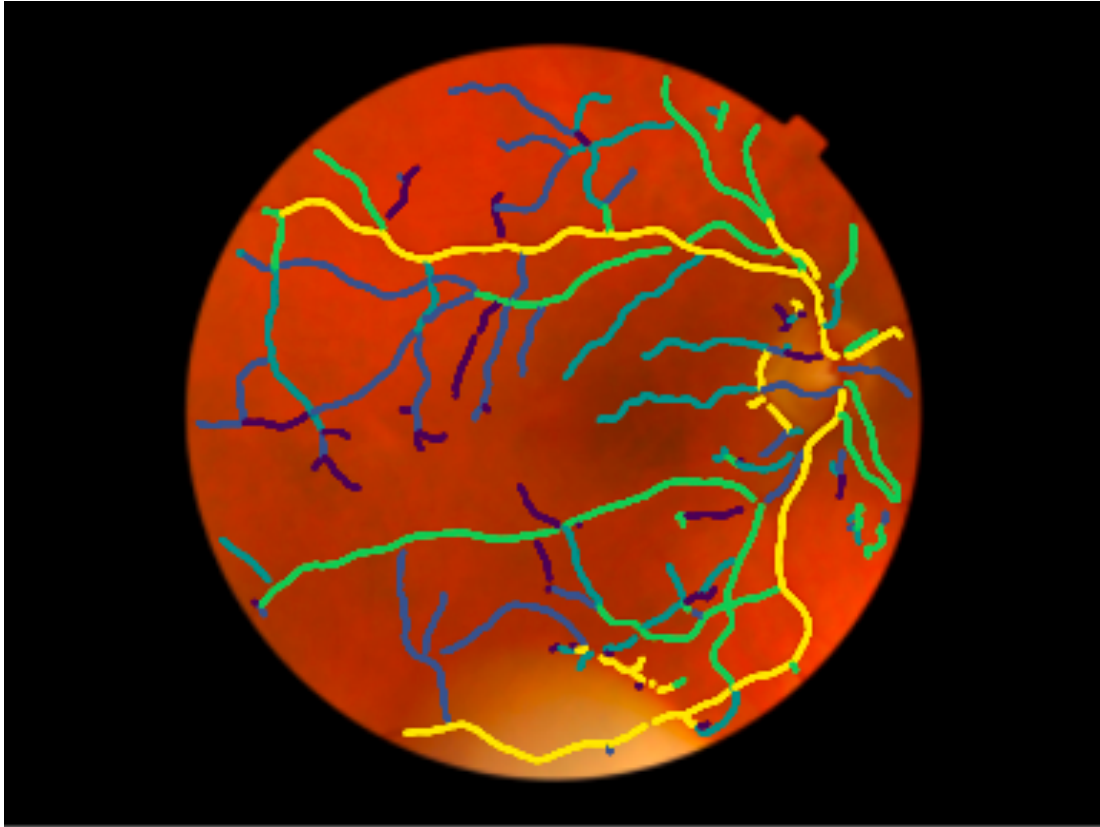


Tortuosity



dissection

Accurately measuring image phenotypes is hard

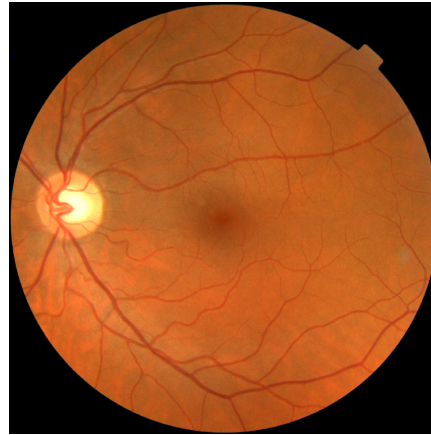


$$\tau_{DF} = \frac{L_{arc}}{L_{chord}}$$

Tortuosity = 1.2

Two sources of error

Technical error

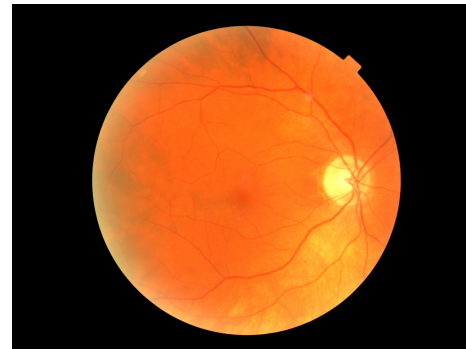


Tortuosity = 1.03



Tortuosity=1.07

Biological “error”



Tortuosity = 1.3



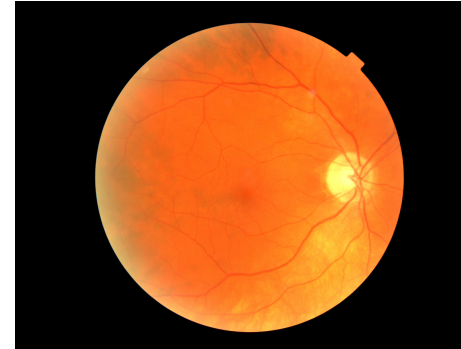
Tortuosity=1.1

Your project – part 1

- Quantify these types of error for various measurements
- What can we say about these measurements?
 - Accuracy
 - Stability

Your project – part 2: Improving GWAS

	Tortuosity
Subject 1	1.4
Subject 2	1.2
.	.
Subject n	1.4
.	.
Subject 65'000	1.05



Tortuosity = 1.7



Tortuosity=1.1

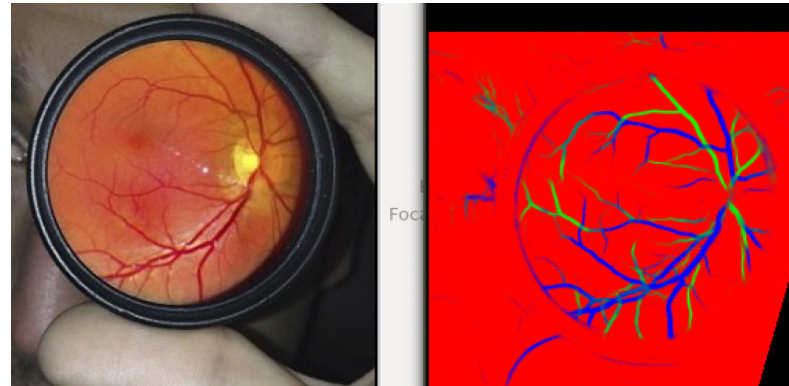
Subject n: tortuosity = 1.4

Your project – part 2: Citizen science



Take your own measurements

Create image segmentation method



You will know your personal scores!

You will learn

- Stats
- Python
- Either GWAS, or image segmentation and your personal vascular scores