On Age Estimation by Using Still Face Images

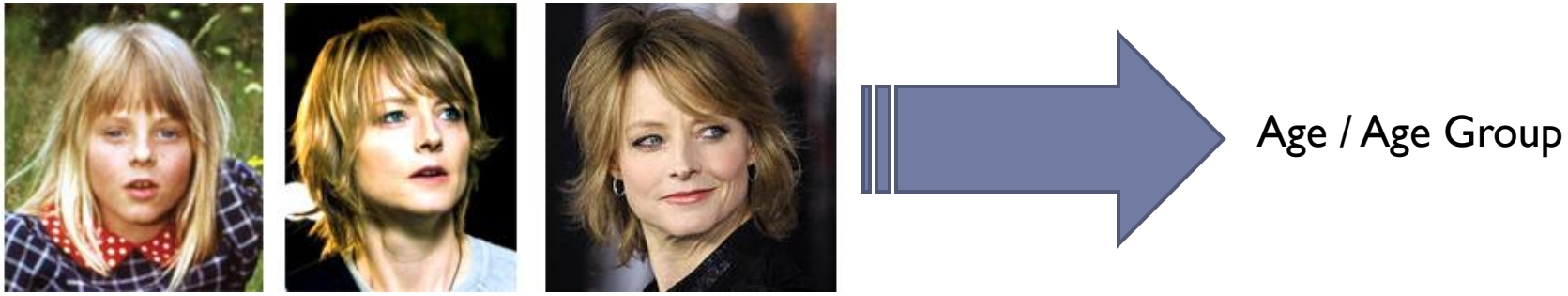
Bilgin Esme

About Aging

- Accumulation of changes in an organism
- The appearance of a human face changes significantly by aging.
- Different aging patterns during different age segments – (childhood, adulthood)
- Facial aging effects are mainly attributed to bone movement and growth and skin related deformations associated with the introduction of wrinkles and reduction of muscle strength.
- Usually bone growth takes place during childhood
- Whereas during adult ages the most intense age-related deformations are linked with texture changes.

Definition of the Problem

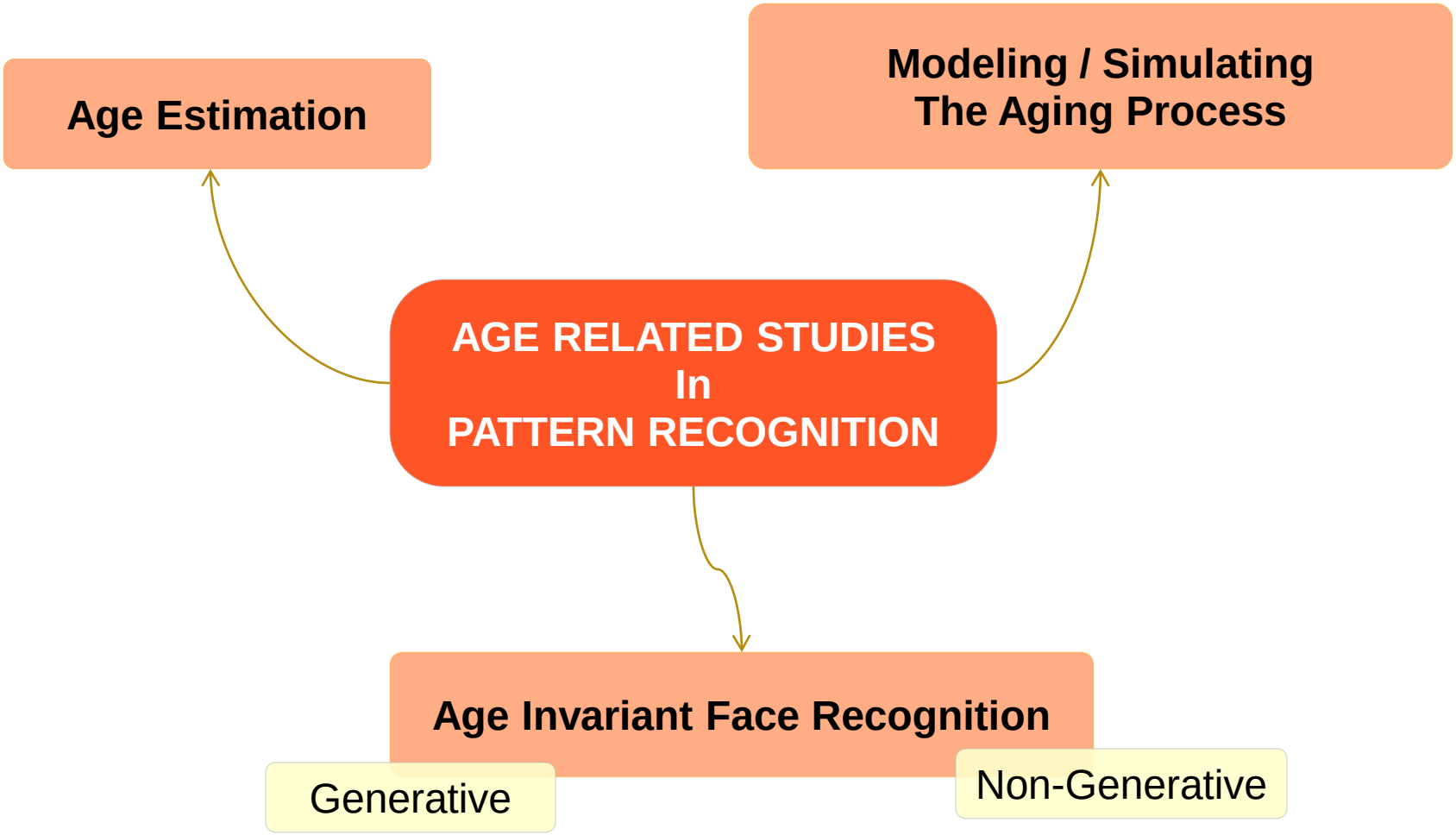
- Implementing algorithms that enable the estimation of a person's age; based on features derived from his/her face image.



Motivation

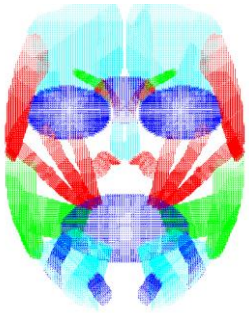
- Age- based access control - prevention of minors to access some internet pages
- Age-specific human-computer interaction – such as adjusting text size for different age groups
- Age-based indexing of face images – photo allbums
- Age-invariant person identification
- Detecting child-pornography

Age Related Studies



Age Invariant Face Recognition

Approaches



Generative

Generative approaches apply a computational model to simulate the aging and then apply subsequent recognition algorithms.

Non-Generative

Non-generative approaches concentrate on deriving “age-invariant signatures” from faces.

Methods Applied so Far

-Removing tilt
-Extracting bulb area
-Extracting only facial texture – no hair
-Resizing to NxM

-PCA
-Local Binary Patterns
-Local Features
-AAM
-Gabor Filters
-Learning Manifolds
-Subspace Analysis
-Gaussian Process Modeling
-Fusion Models

-SVM
-SVD
-K-nearest neighborhood
-Shortest Distance

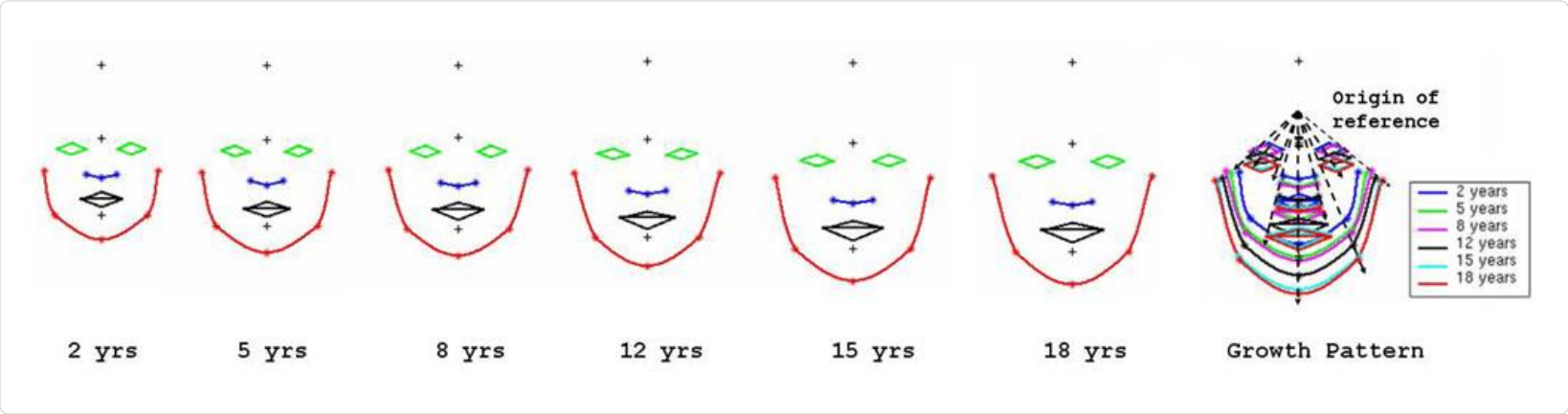
Defining Age Groups

Author / Work	Age Groups
Shan "Learning Local Features for Age Estimation on Real-Life Faces"	0-2 | 3-7 | 8-12 | 20-36 | 37-65 | 66+
Tang, Lu "Age Classification Combining Contour and Texture Feature"	<19 | 19-23 | 24-50 | 50+
Chen, Chang, Ricanek "Face Age Estimation Using Model Selection"	0-9 | 10-19 | 20-29 | … | 80-89 | 90-93 different age groups for different databases
Zhuang, Zhou, Huang, "Face Age Estimation Using Patch-Based Hidden Markov Model Supervectors"	0-9 | 10-19 | 20-29 | … | 60-69 | 70-93
Kwon, Lobo "Age Classification from Facial Images"	baby | adult | senior
Horng, Lee, Chen "Classification of Age Groups Based on Facial Features"	0-2 | 3-12 | 13-19 | 20-29 | … | 90-99| 100+
Lanitis, Draganova, Christodoulou "Comparing Different Classifiers for Automatic Age Estimation"	0-10 | 11-20 | 21-35 up to 35

Generative Approaches

Prototype faces created for different ages using anthropometric measurements

N.Ramanathan, R.Chellappa -
"Modeling age progression in young faces"



The flow of facial features across age, validates the constraints imposed by the craniofacial growth model

Simulating the Aging Process

Original – 41 years

Artificially aged Tarantino
50, 60, 70 and 80 years respectively

M.Gandhi - “A method for automatic synthesis of aged human facial images,”

50 years

60 years

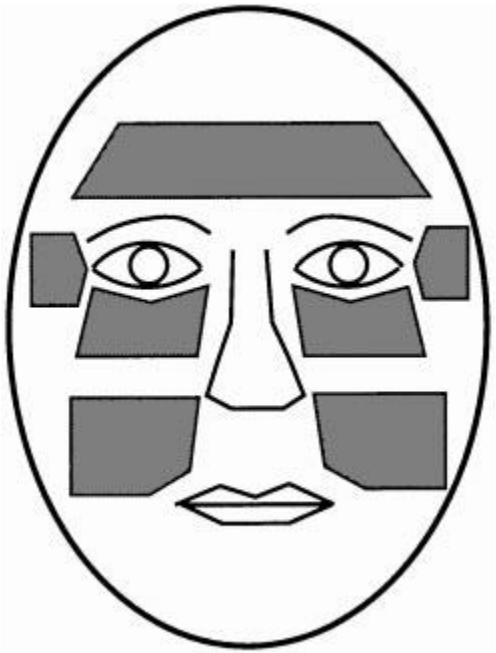
70 years

80 years

Age Estimation

Oval template fitting
for extracting the face blob

Y.H.Kwon, N.da.V.Lobo -
"Age Classification from Facial Images"



Wrinkle geography

This shows the regions that are searched for facial wrinkles after all facial features are located.

Non-Generative Approaches

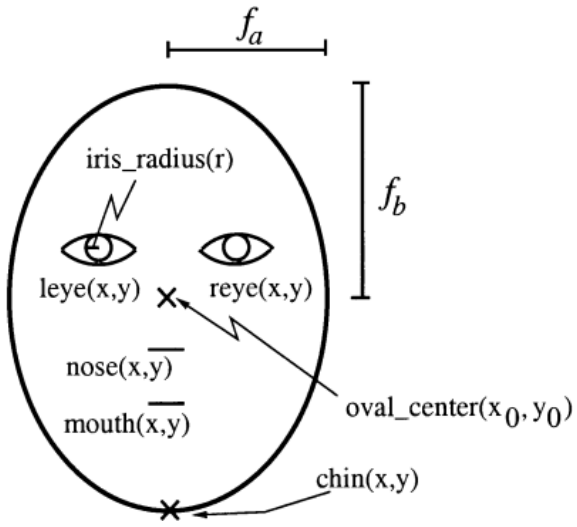
Finding Facial Features

Compute Facial Feature Ratios

Compute Wrinkle Analysis

Conclude age category

Head template including the parameters used for oval-fitting and eye-fitting

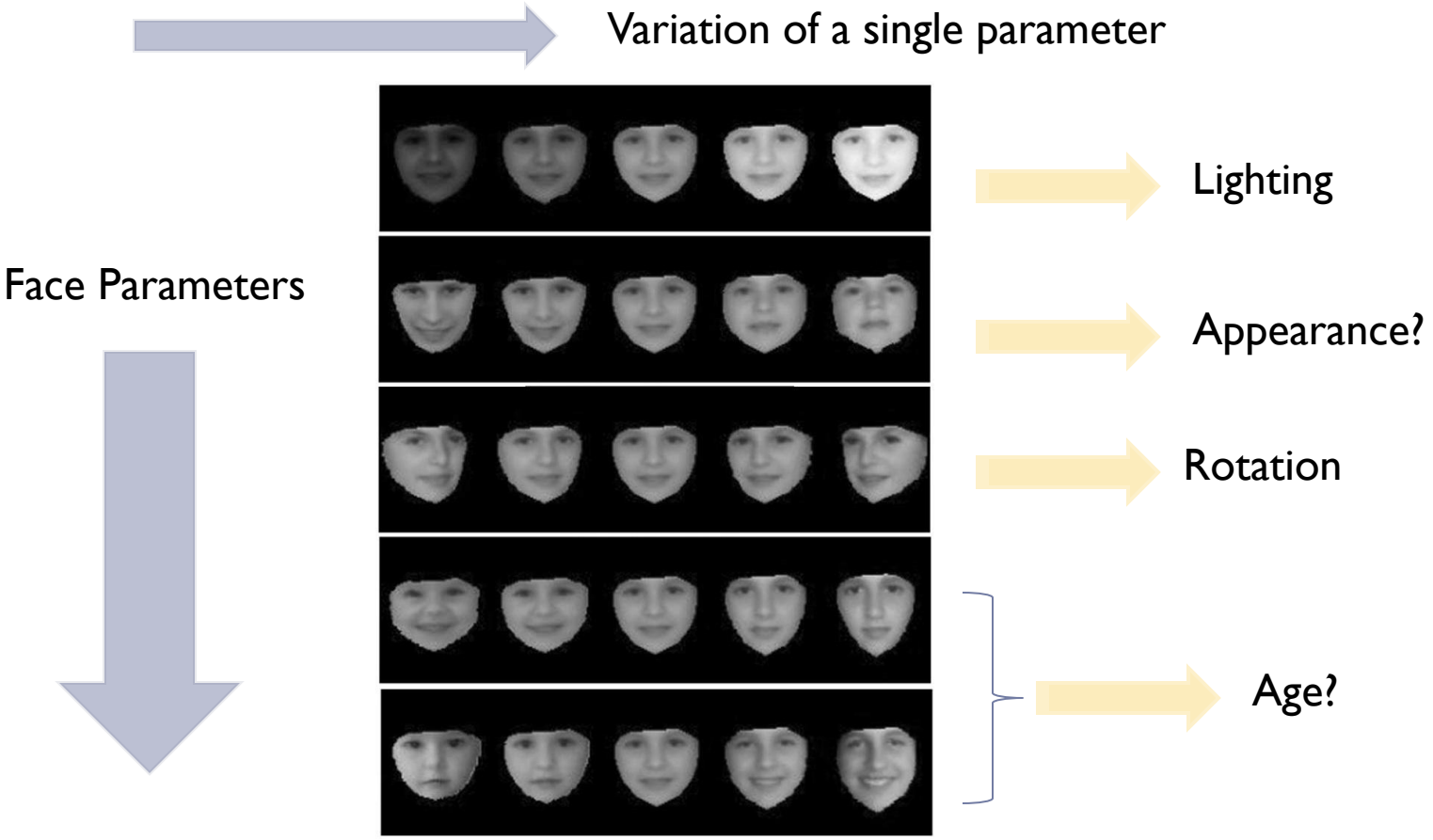


Y.H.Kwon, N.da.V.Lobo -
"Age Classification from Facial Images,"

Classification

Subject	Ratio 1 threshold = 1.48	Ratio 2 threshold = 0.912	Wrinkle snakelets found	Decide wrinkled?	Computed label
Baby14	1.45	0.913	0	No	Baby
Baby17	1.54	0.915	0	No	Baby
Baby22	1.43	0.930	3	No	Baby
Baby24	1.73	1.13	1	No	Baby
Baby25	1.80	0.982	0	No	Baby
Adult01	1.41	0.872	0	No	Adult
Adult04	1.28	0.793	5	No	Adult
Adult05	1.30	0.731	4	No	Adult
A02	1.29	0.936	0	No	Adult
A12	1.20	0.857	0	No	Adult
Snr01	1.19	0.911	56	Yes	Senior
Snr09	1.39	0.78	77	Yes	Senior
Snr13	1.25	0.81	102	Yes	Senior
Snr15	1.36	0.71	59	Yes	Senior
Snr18	1.14	0.81	114	Yes	Senior

Active Appearance Models



Lanitis et. Al.
"Comparing Different Classifiers for Automatic Age Estimation"

Contributors

Approach	Reference(s)
Subspace based	Lanitis *et al.* [18], [19], Geng *et al.* [20], [21] Ramanathan and Chellappa [22], [23] Fu *et al.* [24], Guo *et al.* [25]
Model based	Ramanathan and Chellappa [26] Ramanathan and Chellappa [27] Suo *et al.* [28], Unsang *et al.* [29]
Machine Learning	Gandhi and Levine [30], Ling *et al.* [31] Yang and Ai [32]
Image / Feature driven	Kwon and Lobo [33], Burt and Perrett [34] Tiddeman *et al.* [35], [36], Biswas *et al.* [37]

A Snapshot of Age Estimation Studies

YEAR	AUTHORS	PAPER	FEATURE EXTRACTION / DIMENSIONALITY REDUCTION	CLASSIFICATION / REGRSSION	REF
1999	Kwon, Loboy	Age Classification from Facial Images	AAM, Local Features		
2006	Chellappa, Ramanathan	Face Verification Across Age Progression		Bayesian	
2010	Sethuram, Ricanek	A Hierarchical Approach to Facial Aging	AAM	SVR	
2008	Fu, Huang	Human Age Estimation with Regression on Discriminative Aging Manifold	PCA, Manifold Learning	Robust regression	
2004	Lanitis, Draganova, Christodoulou	Comparing Different Classifiers for Automatic Age Estimation	PCA, AAM	SVR, Neural Networks, Shortest Distance (+hierarchical)	
2009	Geng, Smith-Miles	Facial Age Estimation by Multilinear Subspace Analysis	AAM, N-mode SVD	Multilinear Subspace Analysis	
2009	Ramanathan, Chellappa, Biswas	Age progression in Human Faces : A Survey	SURVEY		
2009	Guo, Mu, Fu, Dyer, Huang	A Study on Automatic Age Estimation Using a Large Database	A comparative evaluation of many approaches against a large database.		

Standard Database

1

MORPH Database

- More than 17,000 images of over 4,000 individuals
- Between ages 15-68.
- Males and females *(not homogeneously)*
- Three different ethnicity *(rather skewed)*.

2

FG-NET

(Face and Gesture Recognition Research Network)

- Over 1000 images of 82 subjects
- Between the ages of -069 years
- Some 68 landmark features identified manually, on all face images
- Informative tags such as image size, age, gender, spectacles, etc.

3

FERET Database

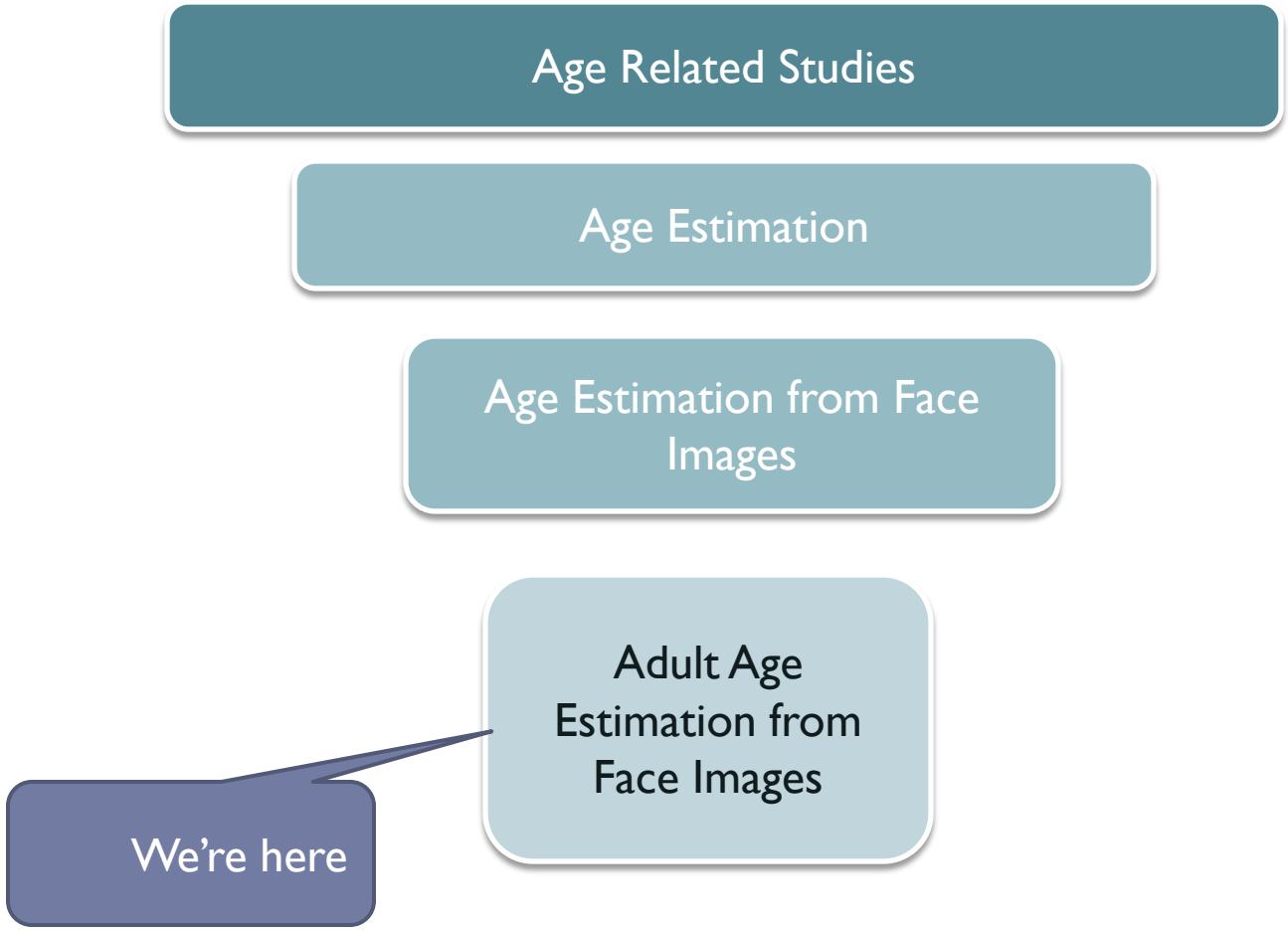
- Large database not specialized only on aging
- Also has variations on illumination, pose and facial expressions
- The images are well tagged and classified for age differences and for other attributes
- The age separation between the instances is 18 months or more
- The database contains over 2,000 images

Hollywood Database

- An alternative to the existing databases
- We'll complete at least 150 persons, with age range of 18-80
- We know the exact ages when the film is shot
- We have literally millions of images around

A sample from Harrison Ford section of the database

Our Work


Age Related Studies
Age Estimation
Age Estimation from Face Images
Adult Age Estimation from Face Images
We're here

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Methodology