

# Quality of Experience - Quality for Telecommunication

Lucjan Janowski, AGH

Artificial Intelligence in Research and Applications Seminar  
(AIRA), 24 October 2024



Lucjan Janowski



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Toulouse, France, 2006-2007





Lucjan Janowski



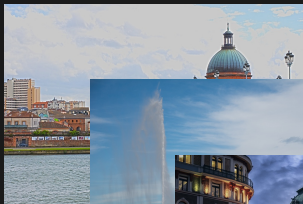
Toulouse

Geneva, Switzerland, 2010-2011

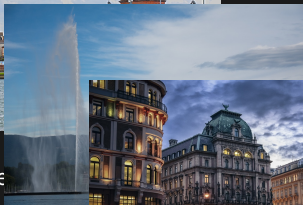




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Toulouse



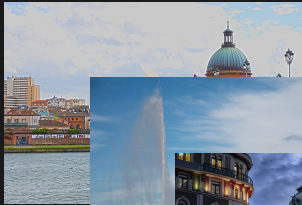
Geneva, S



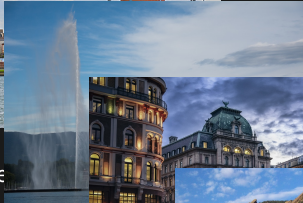
Vienna, Austria, 2014-2015



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Geneva, S

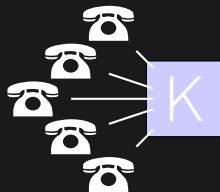


Vienna,

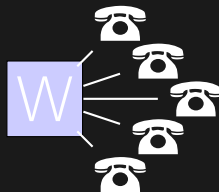
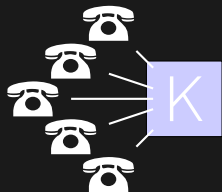


Boulder, Colorado, USA, 2024-2025

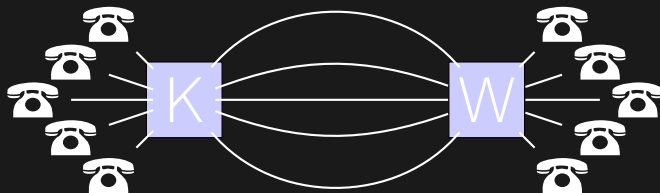
# Classical Telecommunication Problem



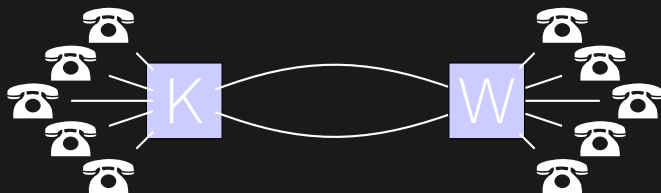
# Classical Telecommunication Problem



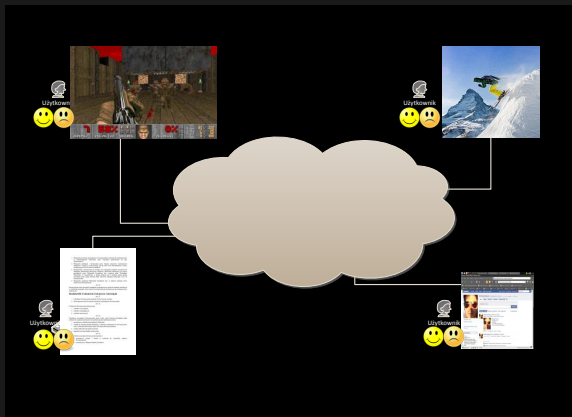
# Classical Telecommunication Problem



# Classical Telecommunication Problem



# Packet Network



Quality: QoS: Quality of Service -> packets delivery

# ISO OSI - Model



Source: <https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcSQYckgiQL1XzRJE9bzQU6vfSCwII-Es1Fsr1GEQJwGd8X01UfkeA>



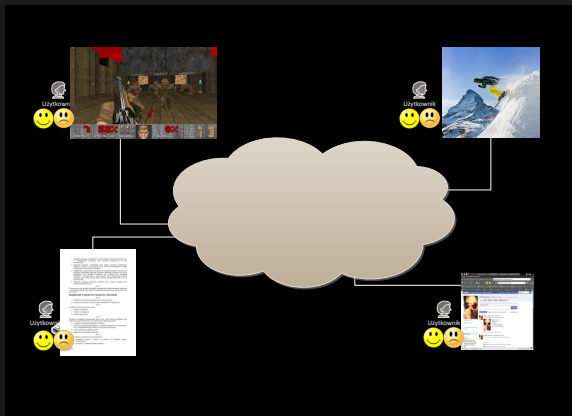
# Extended Model



OSI Layer	Deployment Layer	SOA / OSA
<b>10: Government</b>	User Layer	SOA
<b>9: Organization</b>		
<b>8: Individual</b>		
<b>7: Application</b>	Services Layer	
<b>6: Presentation</b>	Middleware Layer	
<b>5: Session</b>		
<b>4: Transport</b>	Operating System Layer	
<b>3: Network</b>		
<b>2: Data-Link</b>		
<b>1: Physical</b>	Hardware Layer	OSA

Source: ByGvrseostud-Dwnwork, CCBY-SA3.0, <https://commons.wikimedia.org/w/index.php?curid=29156115>

# Packet Network



Quality: QoE: Quality of Experience -> what is a user think about a service?

# What is Quality of Experience?



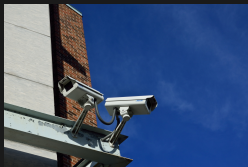
# Who Is the System User?



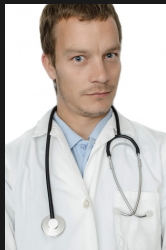
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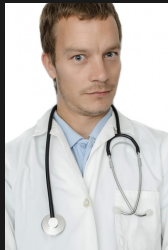
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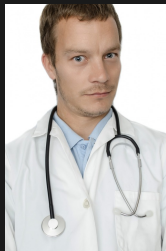


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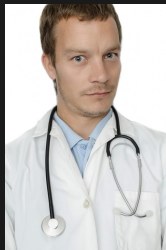
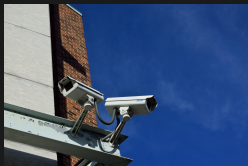




# Subjects, Professional



# Subjects, Professional



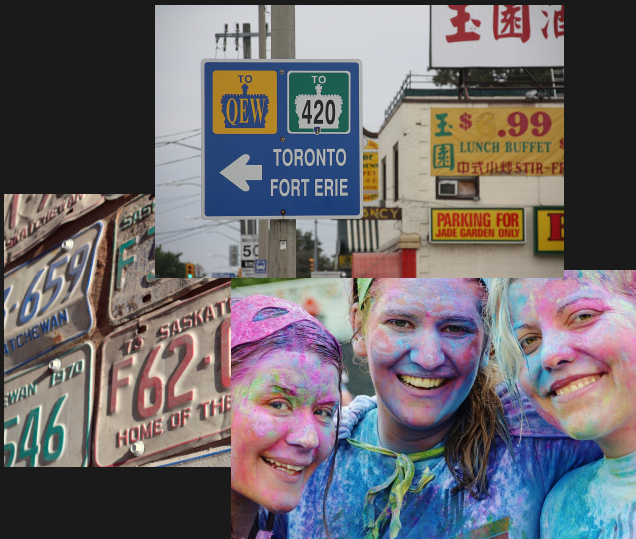
# Professional ITU-T P.912



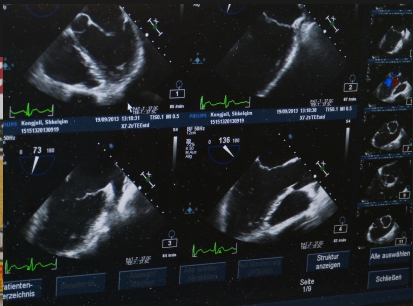
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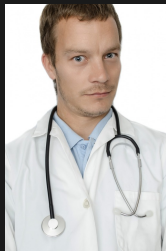
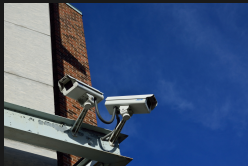
# Professional ITU-T P.912



# Professional ITU-T P.912



# AI





# AI







# AI



→ Accuracy 0.99

# Using AI as a Subject



Accuracy 0.98



# Using AI as a Subject



Accuracy 0.98

Accuracy 0.24

# Using AI as a Subject



Quality 4.9  
↑  
Accuracy 0.98

Quality 2.1  
↑  
Accuracy 0.24

# Using AI as a Subject



Quality 4.9  
↑  
Accuracy 0.98

Quality 2.1  
↑  
Accuracy 0.24

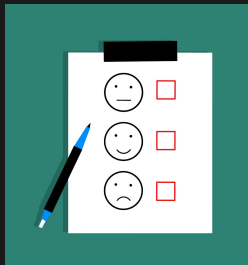
W. Heng, T. Jiang and W. Gao, "How to Assess the Quality of Compressed Surveillance Videos using Face Recognition," in IEEE Transactions on Circuits and Systems for Video Technology.



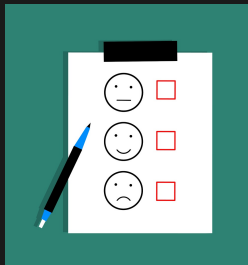
# Quality for AI



# Quality for AI



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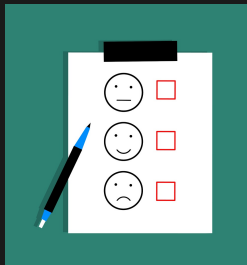
# Quality by AI



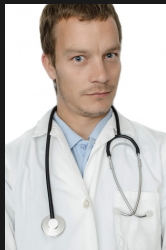
# Quality by AI



# Quality by AI



# Subjects, Entertainment



# Subjects, Entertainment

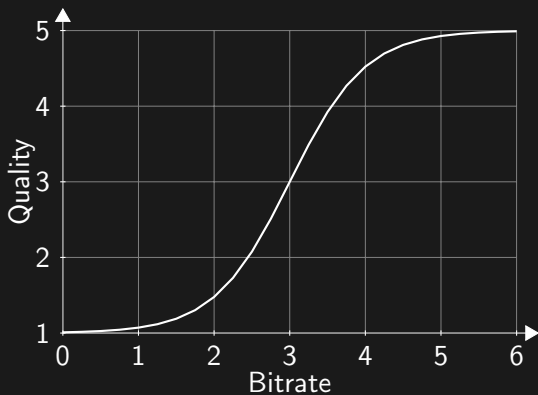




# Subjects



# Continuous Parameters

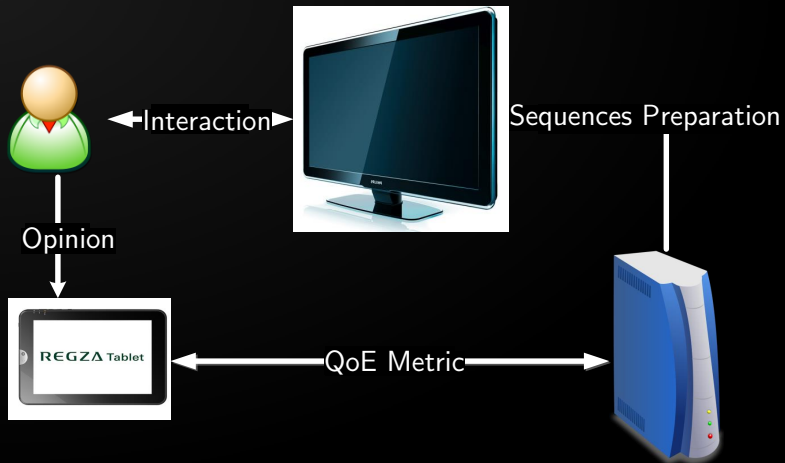


# UX/QoE My Personal Point of View!

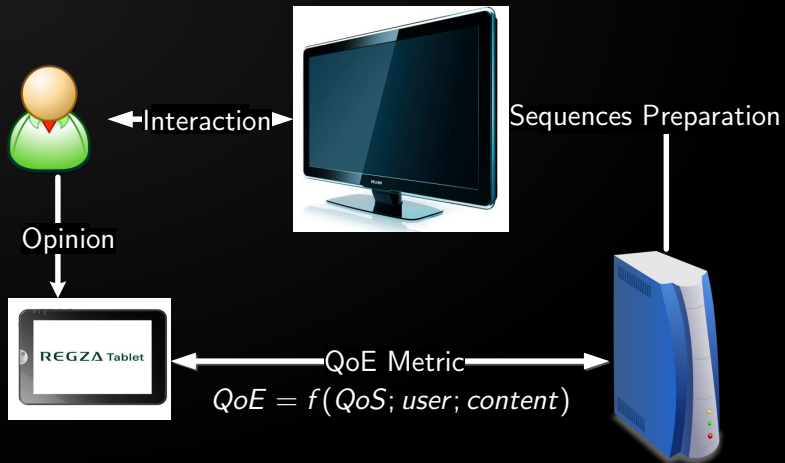


- UX – design a product, focus on usability, design etc.
- UX tools:
  - Interview
  - Focus group
  - field study - observing users
- QoE – specific product: optimize or find boundary against continuous variables like bandwidth, packet loss, delay, battery consumption, etc.
- QoE tools:
  - Repeated tasks with different settings
- The most common example: Video streaming services
  - Focusing on quality (part of VQEG): ...
  - Not so much about quality: ...

# Subjective Experiment



# Subjective Experiment



# Experiment Preparation

SRC1

SRC2

SRC3

HRC1



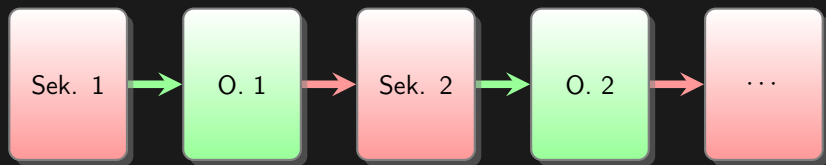
HRC2



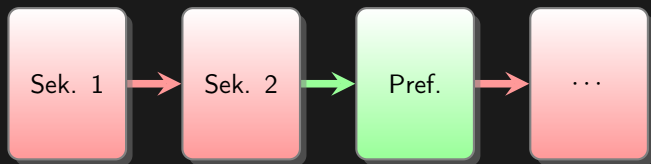
HRC3



# ACR (Absolute Category Rating)

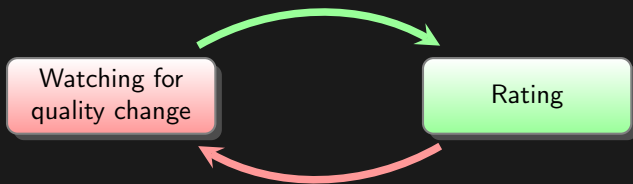


# PC (Pair Comparison)





# SSCQE (Single Stimulus Continuous Quality Rating)



# Subjective Experiment



1,2,3,4,5

# Subjective Experiment



1,2,3,4,5

1,2,3,4,5

# Subjective Experiment



Quality 4.6



1,2,3,4,5

Quality 2.3



1,2,3,4,5



Quality is 3.9

Answer "4": 9 out of 10

Answer "3": 1 out of 10

# ACR versus PC

T. Tominaga, T. Hayashi, J. Okamoto and A. Takahashi, "Performance comparisons of subjective quality assessment methods for mobile video," 2010 Second International Workshop on Quality of Multimedia Experience (QoMEX), Trondheim, 2010, pp. 82-87.



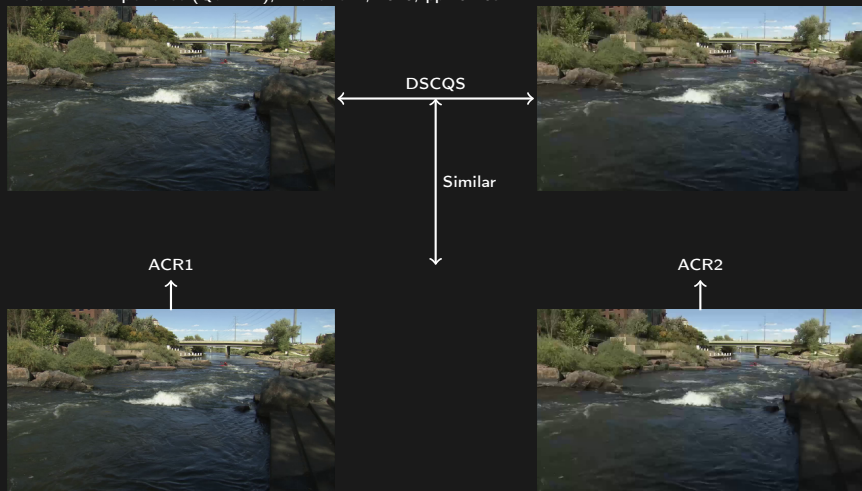
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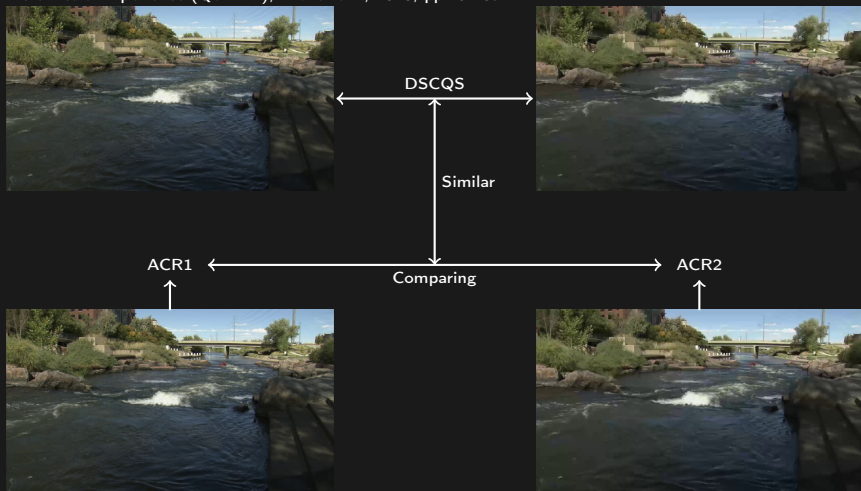


Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychological Review*, 63(2), 81-97.



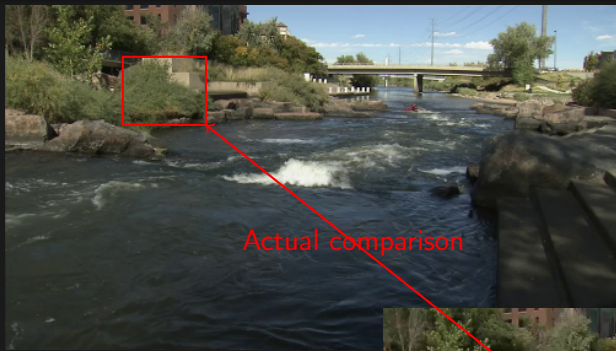
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# Focusing on Region



Actual comparison



- Improve methods used to draw conclusions from subjective experiments
- Understand the process of expressing opinion in a subjective experiment
- Improve subjective experiment design to facilitate analysis and applications
- Improve the analysis of objective model performances

[https://docs.google.com/document/d/1\\_7b3EzCC2viI7va6WtWb1CRBC2t4vBDxrSVaFHDgszc/edit](https://docs.google.com/document/d/1_7b3EzCC2viI7va6WtWb1CRBC2t4vBDxrSVaFHDgszc/edit)

- We need repetition, but interaction means we have different results
- People can cheat our system
- We have to take into account both learning curve and the task being boring

- We can measure a performance
- We can measure body reaction

- We need a task - what is a task watching TV?
- Is a task close to real life scenario? Reading random numbers is a good task not close to reality.
- Can we learn the task? Make it faster after some repetitions
- Can we generate numerous different tasks similar in difficult
- Is it enough engaging for each user in the test

- Developing a task to measure interaction from audio to VR
- The task we investigate is more difficult than the one which are already described - simulating conversation with some real work involved
- We should run first tests in the next month
- I hope to have results from both USA and Poland

- Is there any reaction on bad quality? What is theory behind?
- Body measurements are personal, not necessary easily generalized from one person to other
- With some measurements, like fNIRS, we have limited time before it start to be uncomfortable
- Specific procedures to make an effect visible, like flickering or additional sound directing reaction



- QoE is different from UX
- For application driven services we should know what QoE is needed - example of cloud gaming
- We see problems with classical quality measurements
- New methods for measuring QoE are needed

