PROBLEMS OF DIGITALIZATION

- The heterogeneous nature of historical messages, making it difficult to transform into a digital form acceptable for accumulation and storage.

- Fuzzy concepts and definition.

- A mixture of reality and knowledge about it.

- Misunderstanding of the relative nature of knowledge. Incomplete sources. Messages of different levels of trust.

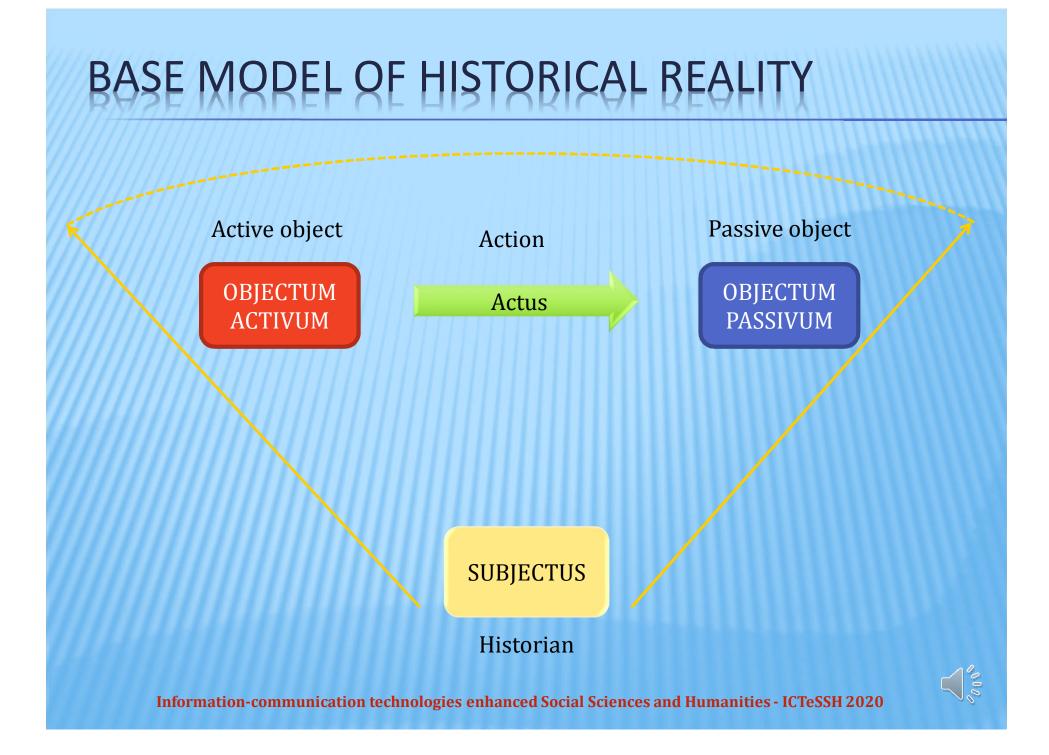- A mixture of social and environmental factors.

SYSTEM APPROACH TO THE HISTORY

- Considering human society as a complex system. History is an evolution process of the society (historical objects).
- Identification of typology and classification of historical knowledge elements
- Formalization of factual knowledge as a rigid structural scheme.
- Universal description format for chronological and spatial data.
- Factual knowledge differentiation by major properties: type and rank.
- Identification of mutual relations between factual knowledge entities (temporary, causal, targeted, typological, genetic, etc.).
- Determination of veracity (reliability) parameters of factual knowledge and their sources.
- Developing an application for historical hypothesizes creation and validation, dating/routes clarification, scientific visualization, etc.

HISTORICAL OBJECTS

- Social (primary)
  - Person
  - Group
  - Organization
- Natural (environmental+transcendental)
- Artificial (artifact)
  - Informational
  - Products
  - AI-generated (artinfacts)

BASE MODEL OF HISTORICAL REALITY

Active object

Action

Passive object

OBJECTUM ACTIVUM

Actus

OBJECTUM PASSIVUM

SUBJECTUS

Historian

KINDS OF PROCESSES

Natural process	Action [Actus]
• form of movement, which is an untargeted change by an object of its own properties • specific for natural objects	• form of movement, which is a targeted change by an object of its own properties • specific for social objects

CATEGORIES OF HISTORICAL REALITY

Event [Obvenientia]

- reflects changes in the properties of the object that occurred at a particular point in time and space
- has no duration, is determined by a specific moment in time and the current state (property values) of the object

Process [Processus]

- reflects the course of changes in their duration, the transition of an object from one state to another
- occurs in time, characterized by duration, start and end events, as well as the result

KNOWLEDGE PROPERTIES OF THE ACTION

Active object— X	• Object implementing action
Operand — A	• Groups of actions by type
Passive object — Y	• Object over which the action is performed
Relative object — Z	• Related object
Target	• Planned result of the action
Effect	• Obtained result (cause of next actions)
Supplement	• Additional information related to the action

KNOWLEDGE PROPERTIES OF THE EVENT

Time - D — Julian date (interval)

Space - L — Geographical coordinates (polygon)

Action — Generating action (see prev.)

Connections — Interrelations

Type — Subgroup division for structuring purposes

Rank — Significance

Veracity — Assessment of the truth and completeness

TYPOLOGICAL AND SIGNIFICANCE PROPERTIES

- Typology
  - domestic policy (unrest, civil war, state, economic and legal)
  - foreign policy (war, embassies, pacts),
  - religious,
  - cultural,
  - biographical,
  - natural (astronomical and climatic phenomena, disasters).
- Rank
  - role of historical action/event in the global process and establishing the degree of its impact on the subsequent course of history
  - ranging from universal significance (super-important, rank 0) to personal significance (negligible, rank 9)
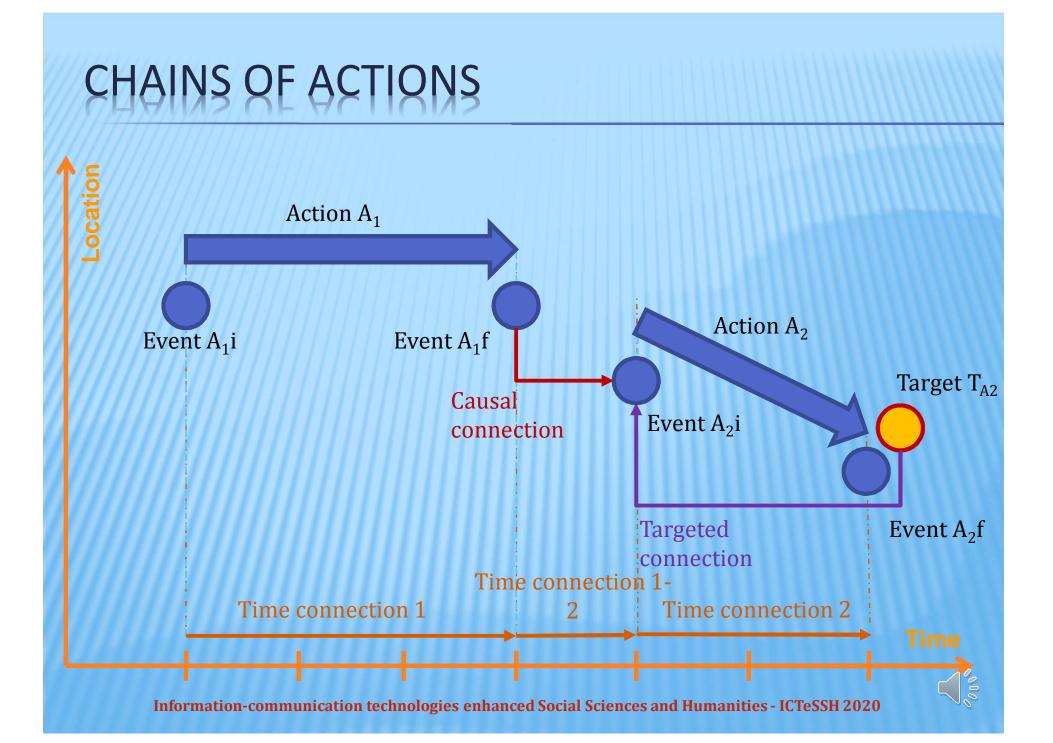
SPACE & TIME PROPERTIES

- Time accounted by **Julian date**
    - the count of days that have passed since Monday, January 1, 4713 BC. e. julian calendar
- Location describes by **Geographical coordinates**
    - latitude, longitude and altitude
- Time interval acts as a typical temporal and polygons as spatial characteristics
    - apparatus of fuzzy interval logic and networks

KNOWLEDGE VERACITY

- **Veracity** [testatus] – assessment of knowledge in terms of its validity and evidence.
- Establishment of veracity is provided by empirical confirmation, experimental data, judgment of the scientific community, public practice, i.e. multisubjective assessments.
    - Expert estimates
    - Logical consistency
    - Mathematical probabilistic methods
    - Trust in the source
- Represents by interval from absolutely reliable (1.0) to absolutely unreliable (0).

CHAINS OF ACTIONS

PROPERTIES OF CAUSAL CONNECTION

Cause
- Cause-event

Effect
- Effect-event

Intensity
- Degree of influence of the cause

Modus
- Promotional or obstructive direction

Veracity
- Assessment of the truth and completeness

Supplement
- Connections and related information

FACTOGRAPHIC DATABASE EXAMPLE

Overlay labels: *Time-plan date · Space-geocoordinates · Rank · Type · Active object · Action · Passive object · Circumstances · Historical sources · Publications*

N	%	t.p.q.	t.a.q.	Δt	год	мес	д.		категор	objectum activum	actio	objectum passivum	circumstat	источники	исследовани
1	1	2046189	2046280	92	0890.	03...05.	.	2	P.ex	сицилийские арабы	восстали	против эмира Ифрикии		ChrMin 45.30 [Schreiner I 335] ("6398	
2	1	2046130	2046494	365	0890.		.	3	P.ex	арабская армия	вторглась	в фему Анатоликов			
3	1	2046130	2046494	365	0890.		.	3	P.ex	Никифор Фока	совершил поход	на Адану	вернулся		
4	1	2046255	2046255	1	0890.		06.	4	R.chr	Псамафийский мон-рь	освящен		построен	VEuth 5 [ПсамХр, 37-38]	
5	1	2046531	2046531	1	0891.		06.	3	Z.vit	бывший патриарх Фотий	умер		в ссылке	[Красносельцев, Типик, 12]	
6	1	2046495	2046859	365	0891.		.	3	Z.vit	Евдокия, дочь Льва VI и	умерла			VEuth 6 [ПсамХр, 40]	
7	1	2046495	2046859	365	0891.		.	3	P.in, R.	Лев VI	вступил в конфликт	с синкеллом Евфимием	из-за	VEuth 6 [ПсамХр, 41-42]	
8	1	2046495	2046859	365	0891.		.	3	P.ex	эмир Язаман	выступил по суше и морю	вдоль юж. берегов Малой	умер во		
9	1	2046860	2047225	366	0892.		.	3	P.ex	посольство кор. Арнульфа	прибыло	в Болгарию	для		
10	1	2046860	2047225	366	0892.		.	1	P.in, R.	Владимир-Расате	выступил	против христианства			
11	1	2047104	2047133	30	0892.		.		P.in	халиф аль-Мутамид	умер		в возрасте		
12	1	2047104	2047133	30	0892.	09.			P.in	аль-Мутадид	провозглашен	халифом	после		
13	1	2047312	2047312	1	0893.		28.	3	P.in	Борис-Михаил	поставил	князем Болгарии мл. сына	после		28.3.893: Курилов
14	1	2047226	2047590	365	0893.		.		P.ex	арабский флот	осадил	Самос			893: Васильев [Виз
15	1	2047226	2047590	365	0893.		.		P.ex	Византия и Армения	заключили союз		против		
16	1	2047226	2047590	365	0893.		.	2	R.chr	Климент Охридский	избран	епископом Болгарским			
17	1	2047226	2047590	365	0893.		.	3	P.ex	Стилиан Зауца	притесняет	болгарских купцов			889...893: Каждан
18	1	2047362	2047363	2	0893.	05.	17/18.	3	R.chr	патриарх Стефан	умер			Красносельцев, Типик, 12 (дата); VThe	
19	1	2047438	2047468	31	0893.	08.		3	R.chr	Антоний II Кавлей	избран	патриархом		ThC VI Leo 8	
20	1	2047560	2047649	90	0893...0894.	12...02.	.	1	P.ex	Симеон Болгарский	объявил войну	империи			
21	1	2047650	2047771	122	0894.	03...06.	.	2	P.ex	болгарские войска	разбили	армию стратилата Кринита	в		
22	1	2047650	2047771	122	0894.	03...06.	.	2	P.ex	Византия и венгры ("турки")	заключили союз		против	ThC VI Leo 9/ПВЛ под 6410 (902) г.	
23	1	2047711	2047833	123	0894.	05...08.	.	2	P.ex	доместик схол Никифор Фока и друнгарий флота	посланы	против болгар с сухопутной армией и		ThC VI Leo	
24	1	2047711	2047833	123	0894.	05...08.	.	3	P.ex	посол Льва VI Нестор	прибыл	в Болгарию	для	ThC VI Leo 9	
25	1	2047711	2047833	123	0894.	05...08.	.		P.ex	Никита Склир	переправил	венгров	через Дунай		
26	1	2047742	2047863	122	0894.	06...09.	.	1	P.ex	венгры	наносят поражение	болгарам	на Ниж.	ThC VI Leo 9	
27	1	2047742	2047863	122	0894.	06...09.	.	2	P.ex	византийцы	выкупили	болгарских пленных у			
28	1	2047803	2047894	92	0894.	08...10.	.	1	P.ex	Симеон Болгарский	заключил перемирие	с Византией		ThC VI Leo 9	
29	1	2047834	2047924	91	0894.	09...11.	.	3	P.ex	посол Льва VI магистр Лев	прибыл	в Болгарию	для		
30	1	2047956	2048320	365	0895.		.	4	Z.vit	Феодор Гуцуниат, муж Зои	умер			VEuth 7 [ПсамХр, 43] (Гуцуниат; "немн	
31	1	2048269	2048269	1	0895.	11.	10.	3	Z.vit	августа Феофано	умерла			Typic. CPolit. [Крас 10.11.895: Каждан	
32	1	2047956	2048686	731	0895...0896.	.		2	P.ex	Византия и Сицилия	заключили перемирие		на 40	ChrMin 45.30 [Schreiner I 335] ("6404	
33	1	2048260	2048351	92	0895...0896.	11...01.		1	P.ex	Симеон Болгарский	разгромил	венгров	в союзе с		
34	1	2048290	2048351	62	0895...0896.	12...01.		4	Z.fam,	Стилиан Зауца	предложил породниться	доместику Никифору Фоке		ThC VI Leo 10 [СВ, 359.17–20] ("Поско	
35	1	2048290	2048351	62	0895...0896.	12...01.		3	P.in	доместик Никифор Фока	смещен		по	ThC VI Leo 10 [СВ, 359.17 ("Поско	
36	1	2048290	2048351	62	0895...0896.	12...01.		3	P.in	магистр Лев Катакалон	назначен	доместиком схол		ThC VI Leo 10 [СВ, 855]	
37	1	2048321	2048380	60	0896.	01...02.		1	P.ex	Симеон Болгарский	разгромил	армию доместика Льва	при	ThC VI Leo 10	896: Златарски [И
38	1	2048321	2048686	366	0896.		.	3	P.ex	выкупленные у венгров	переданы	болгарскому послу	по	ThC VI Leo 9	

FACTUAL KNOWLEDGE & HYPOTHESIS ANALYSIS

Historical fact (factum) — formalized messages (knowledge) about the event/action

Reliable fact - verified information about the event with high veracity values (0.7 ... 1)	Weakly reliable fact - verified information about the event with average veracity values (0.3 ... 0.7)	Unreliable fact (factoid) - verified information with low confidence values (0 ... 0.3)	Counterfact - information about a hypothetical event that was not realized in reality (0)

APPROACH APPLICATION POSSIBILITIES

- Clarifying dates and routes
- Search for implicit regularities
- Predictive capabilities
- Automatic narrative generation
- Scientific visualization
- History of IoT and AI activity

APPROACH DISCUSSION FACILITIES

- Seminar «Problems of the theory and methodology of history: information and communication aspects» (on-line participation)
  - The aim of the seminar is to give a new impetus to the methodology of historical knowledge in the era of intelligent information technology and convergence of branches of knowledge.
- Open e-journal **«TESTIS TEMPORUM: History and Humanities in the Digital Age»** http://ttemp.org/
  - An open international scientific platform for a comprehensive and free discussion of modern problems of historical science and all related humanitarian disciplines.
  - Invites authors and reviewers

THANK YOU!

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Information-communication technologies enhanced Social Sciences and Humanities - ICTeSSH 2020