

# Digitalna era: kraj ili novi početak?

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Mislav Balković  
Sveučilište Algebra

**DIGITALNA  
TRANSFORMACIJA  
I BUDUĆNOST  
OBRAZOVANJA**

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11. 4. 2024., Sveučilište Algebra

Will A.I.

take my job?

Automate  
Automate  
Automate

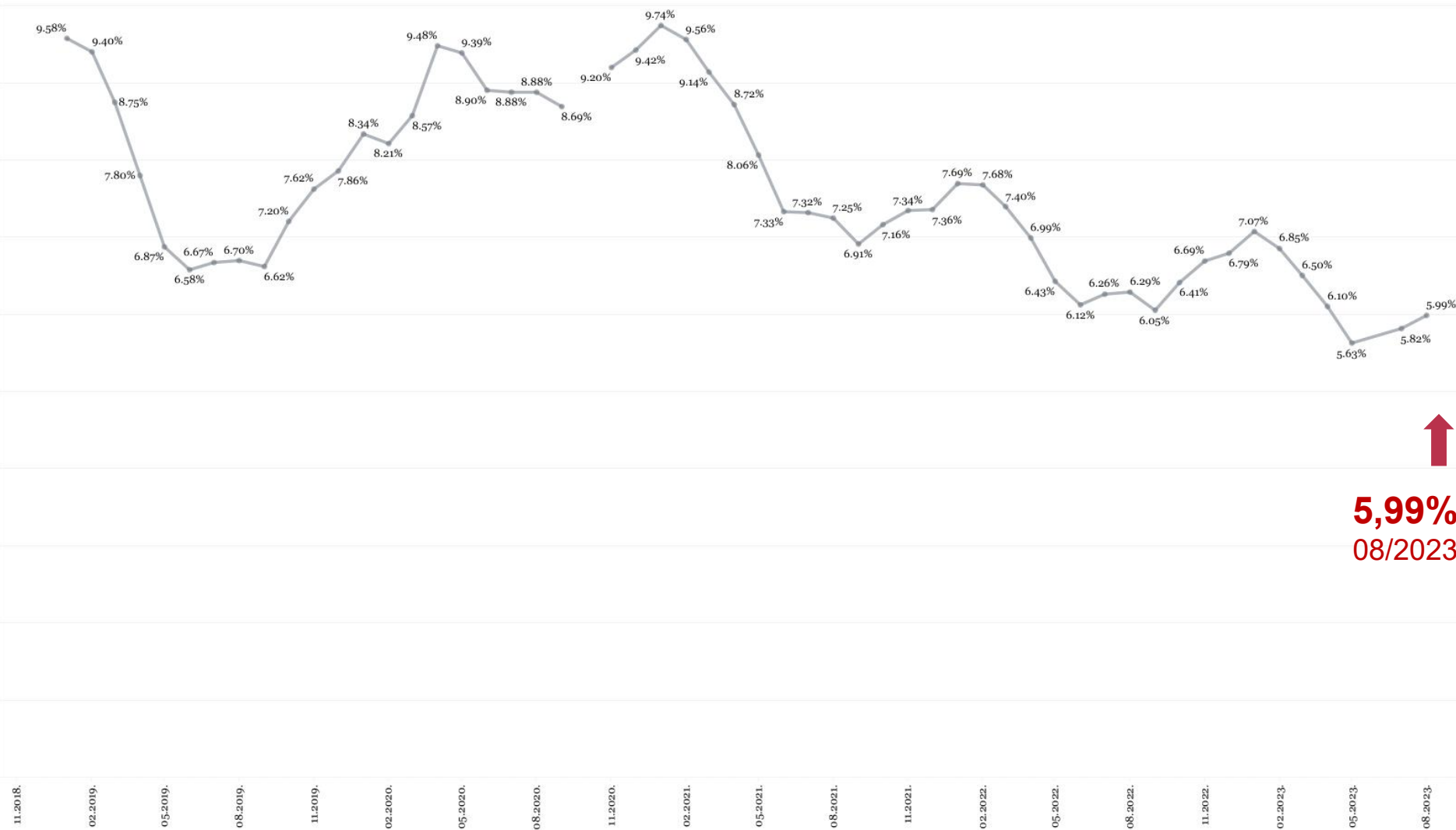
Jobs  
Jobs  
Jobs

# Ali krenimo redom...

- kontekst tržišta rada i demografije
- kontekst korištenja digitalne tehnologije
- kontekst stvaranja digitalnih sadržaja

↓ **9,58%**  
11/2018

Stopa nezaposlenosti



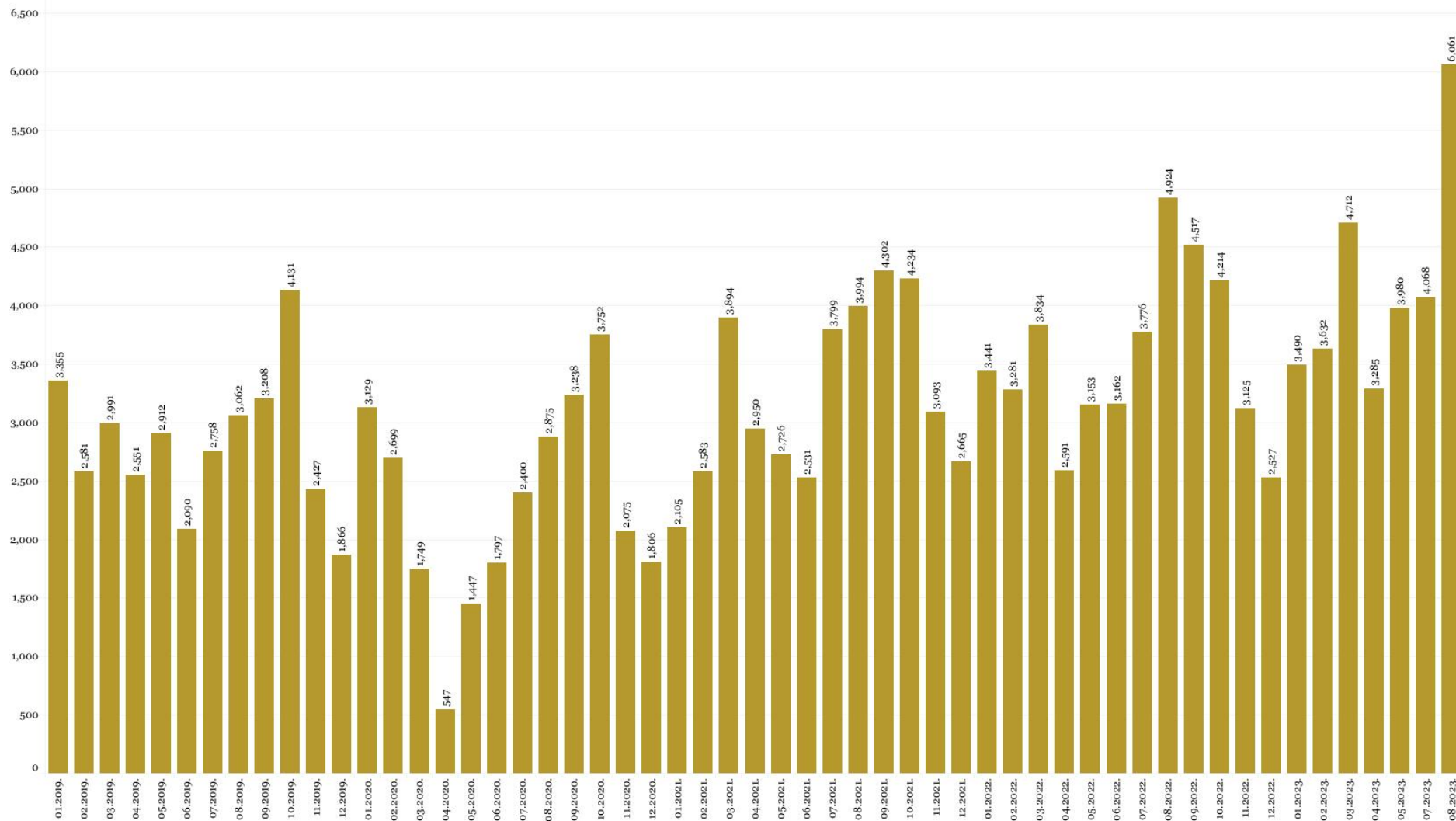
↑ **5,99%**  
08/2023

**Rekordno  
niska  
nezaposlenost**



# Nikad veća potreba za radnicima

Potrebe za radnicima



01/2019

08/2023

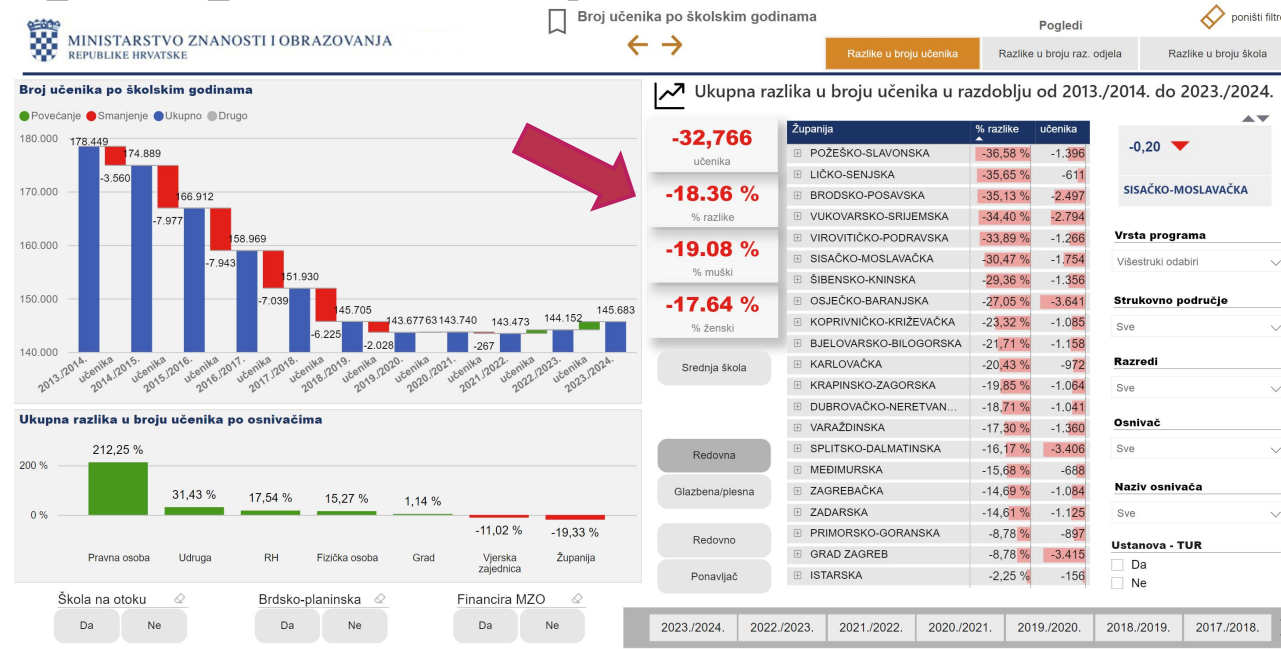
# Nikad manje djece i mladih



U 10 godina pad ukupnog broja učenika u srednjim školama

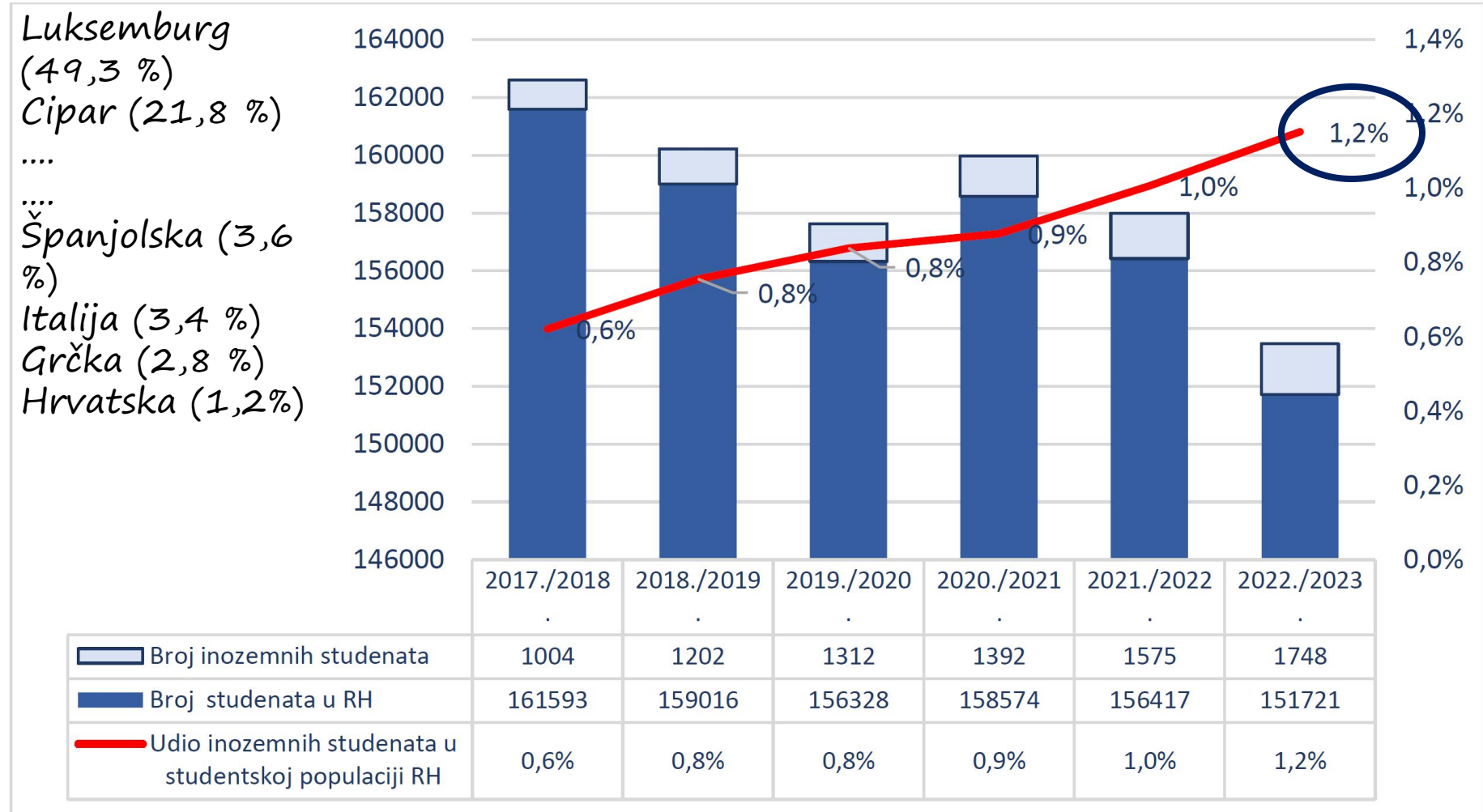
# Demografija u Hrvatskoj

U 10 godina pad ukupnog broja učenika u osnovnim školama



| Šifra | Naziv ustanove | Županija | Općina/grad | Mjesto | Program |
|-------|----------------|----------|-------------|--------|---------|
| Sve   | Sve            | Sve      | Sve         | Sve    | Sve     |

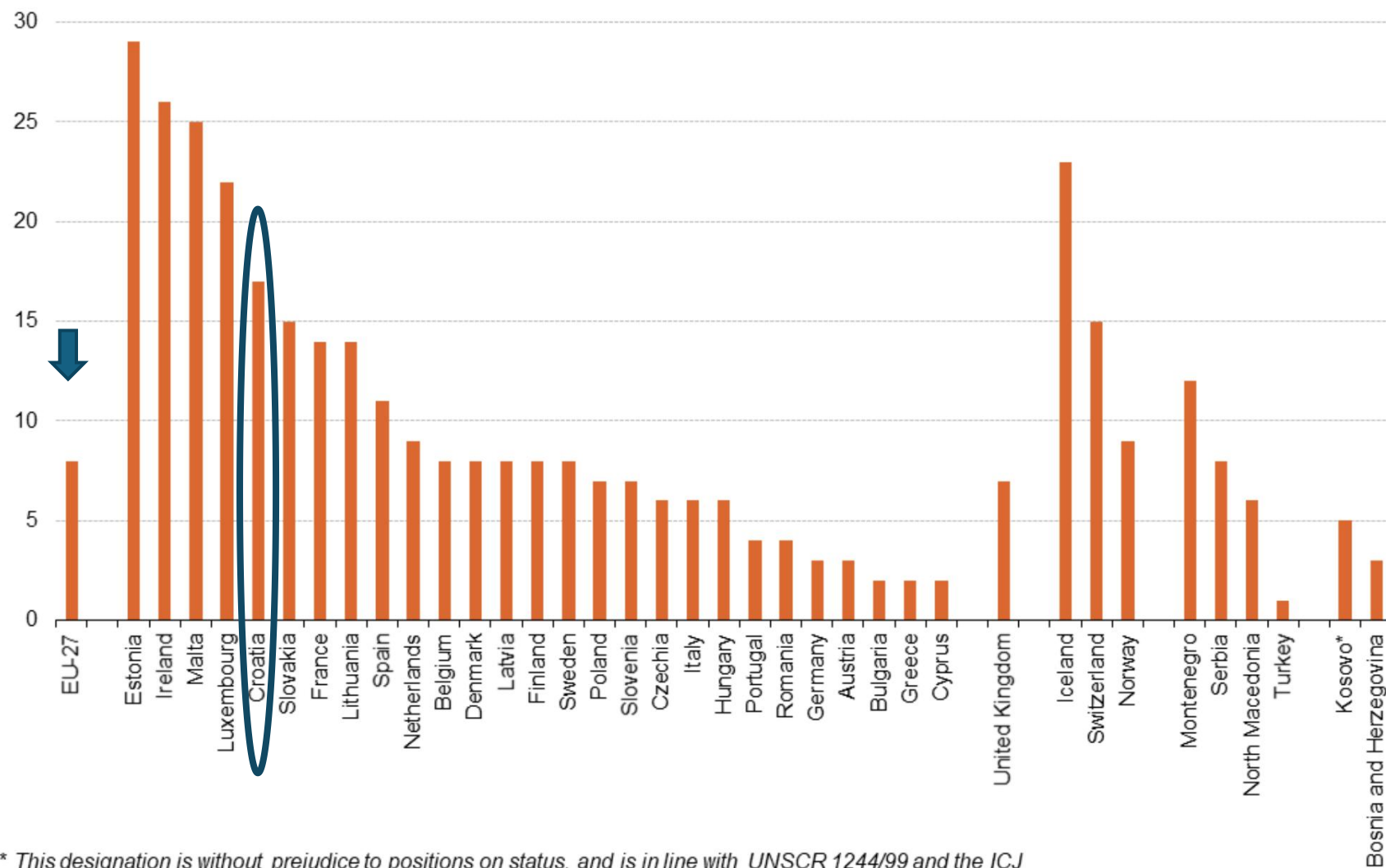
**Mizerni rezultati u privlačenju stranih talenata**



Izvor: AMPEU, „Inozemni studenti na cjelovitom studiju u Hrvatskoj od 2017. do 2022.“

# Gdje je Hrvatska u korištenju digitalne tehnologije?

Individuals who used any website or app to **arrange a transport service** from another individual in the 12 months prior to the survey, 2019  
(% of individuals aged 16 to 74)



\* This designation is without prejudice to positions on status, and is in line with UNSCR 1244/99 and the ICJ Opinion on the Kosovo declaration of independence.

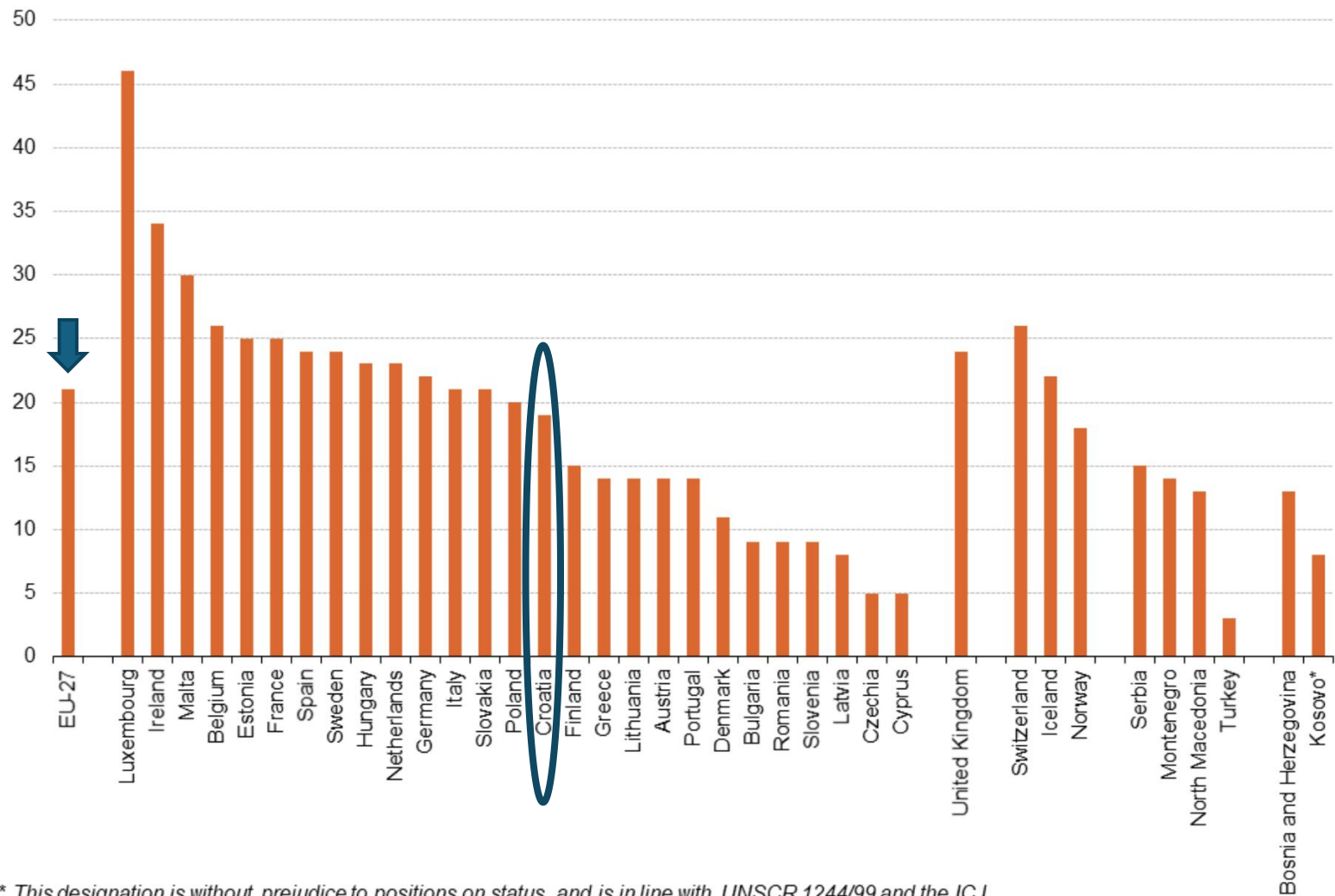
Source: Eurostat (online data code: isoc\_ci\_ce\_i)



# Gdje je Hrvatska u korištenju digitalne tehnologije?

## Individuals who used any website or app to **arrange accommodation** from another individual in the 12 months prior to the survey, 2019

(% of individuals aged 16 to 74)



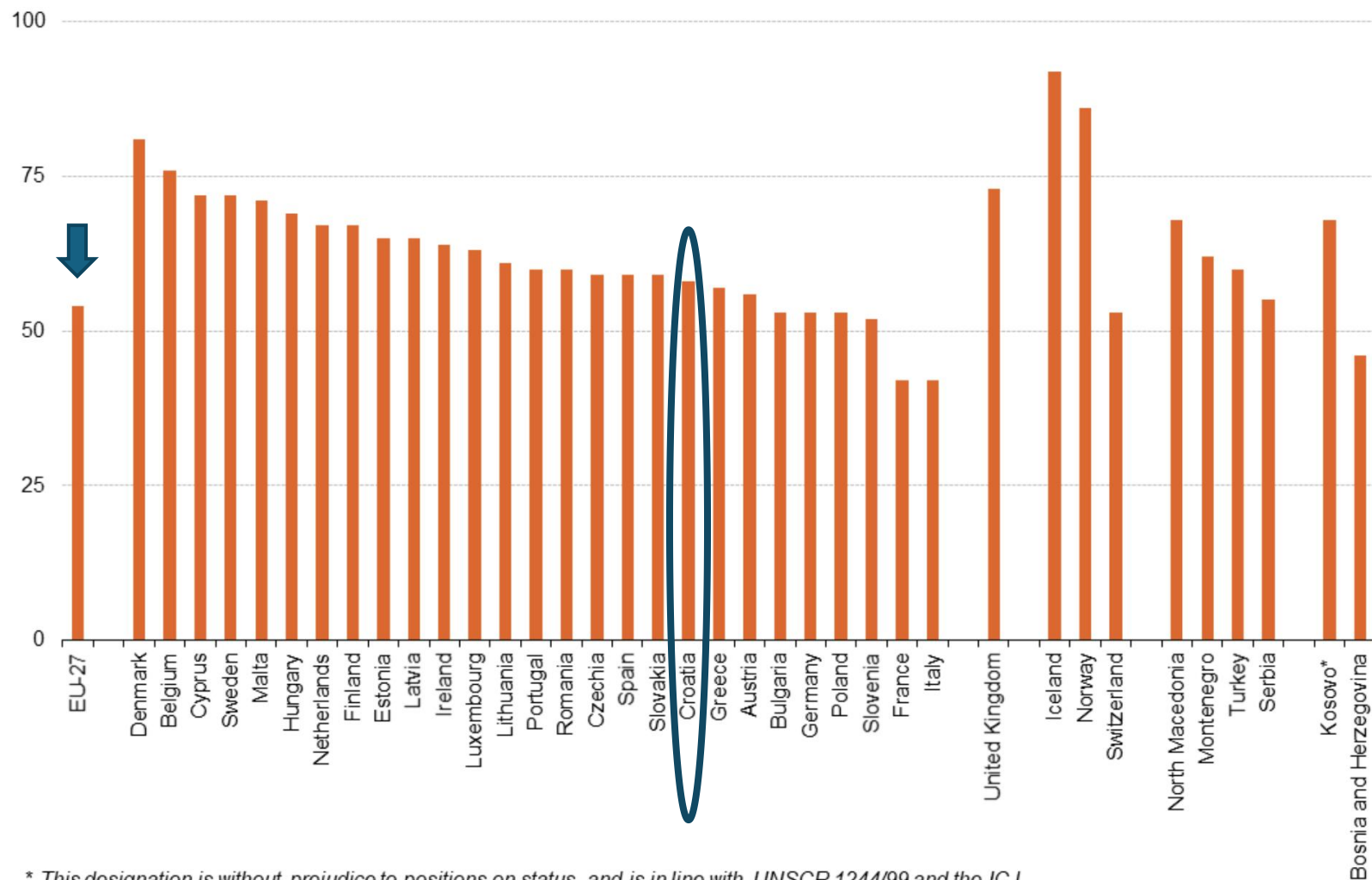
\* This designation is without prejudice to positions on status, and is in line with UNSCR 1244/99 and the ICJ Opinion on the Kosovo declaration of independence.

Source: Eurostat (online data code: isoc\_ci\_ce\_i)

# Gdje je Hrvatska u korištenju digitalne tehnologije?

## Individuals who used the internet for participation in social networking, 2019

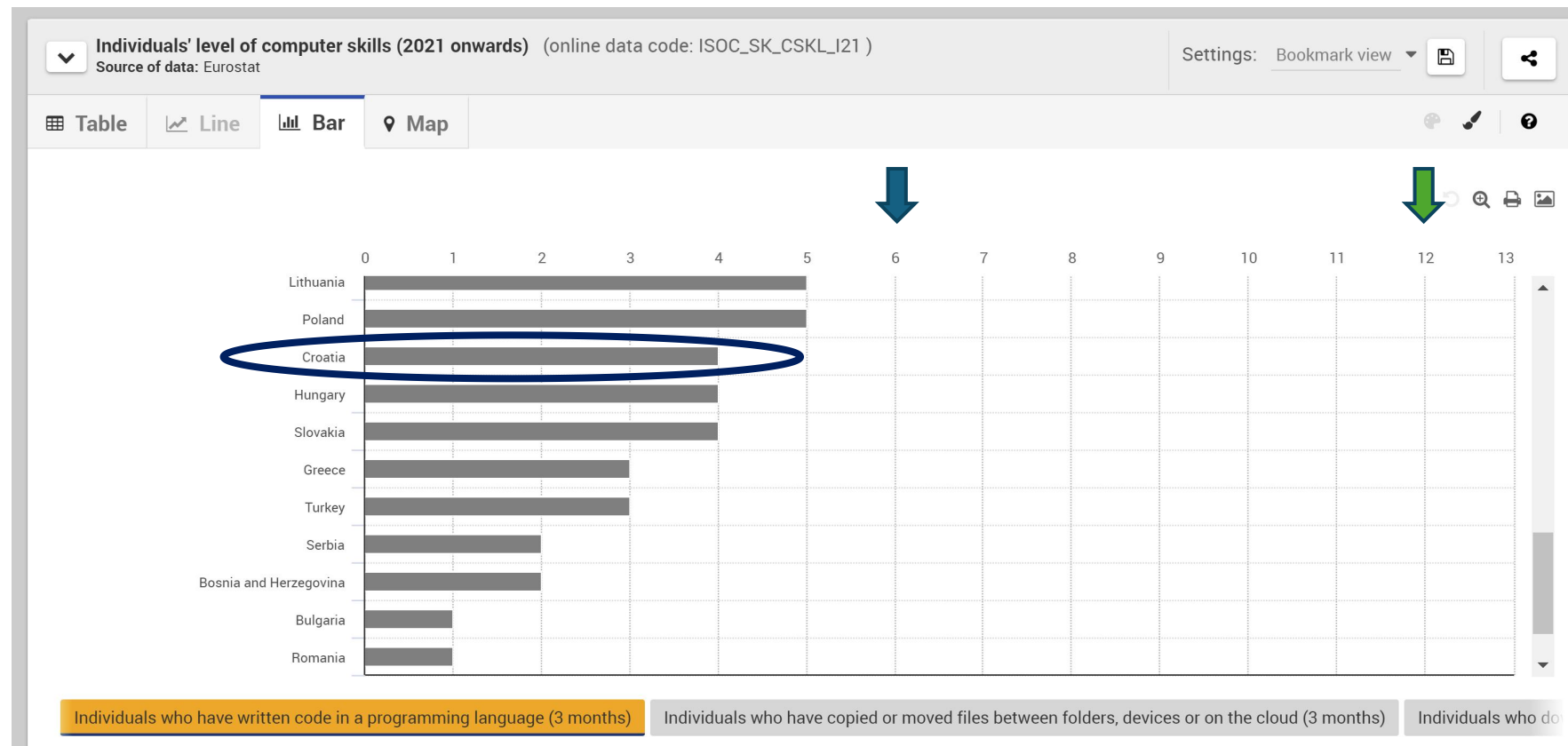
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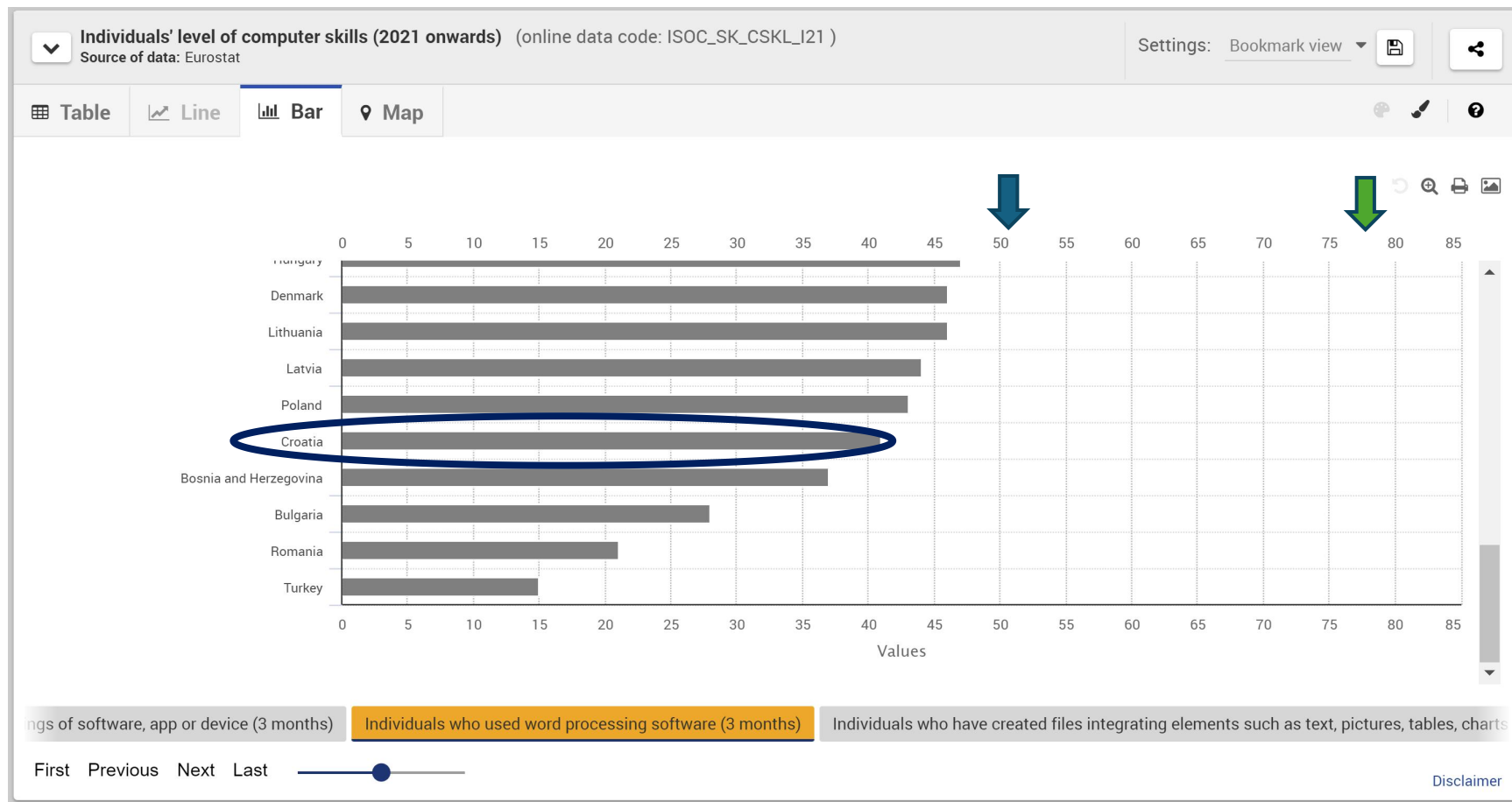
Source: Eurostat (online data code: isoc\_ci\_ac\_i)

# Gdje je Hrvatska u stvaranju digitalnih sadržaja?



Izvor: Eurostat, ICT usage in households and by individuals (isoc\_i) za 2021.

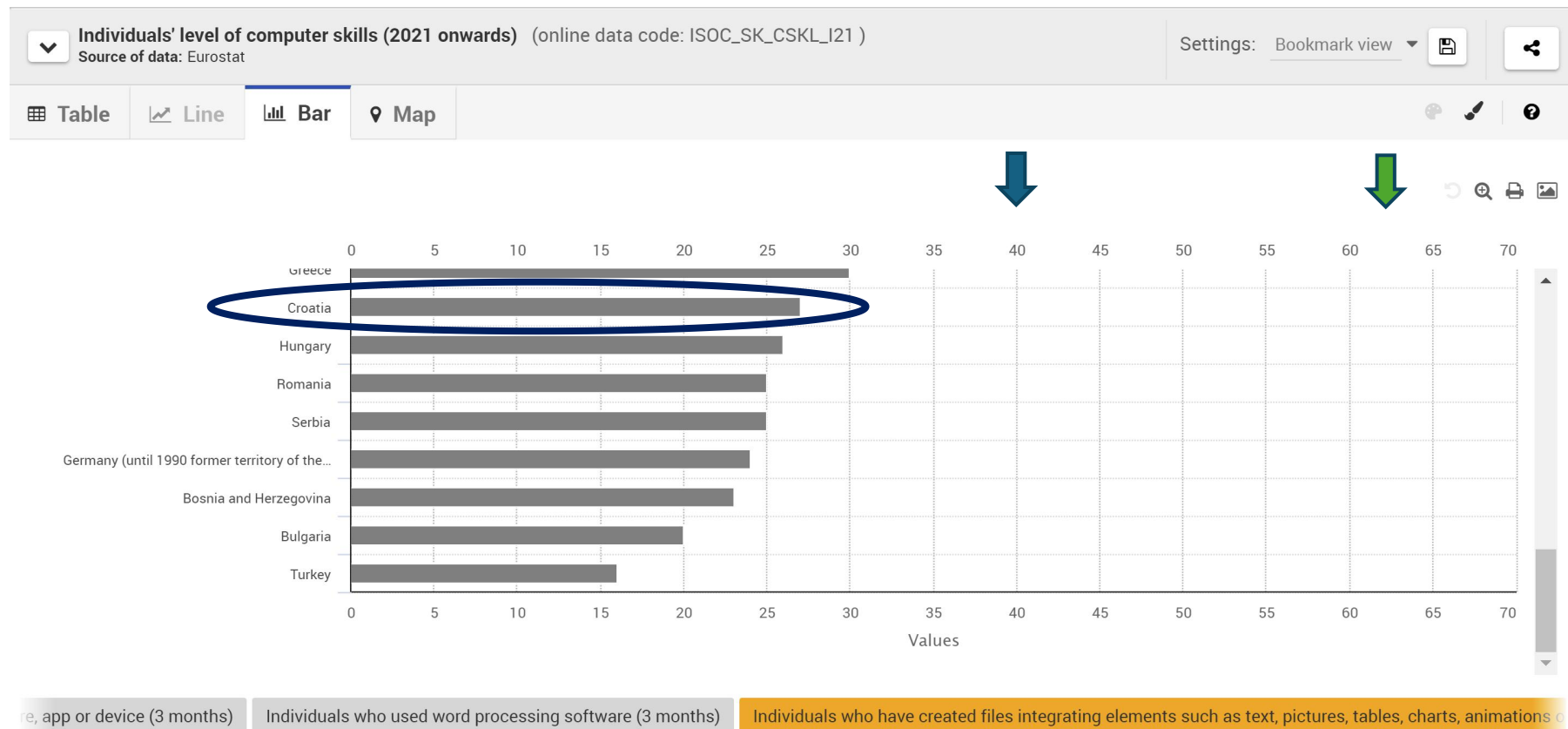
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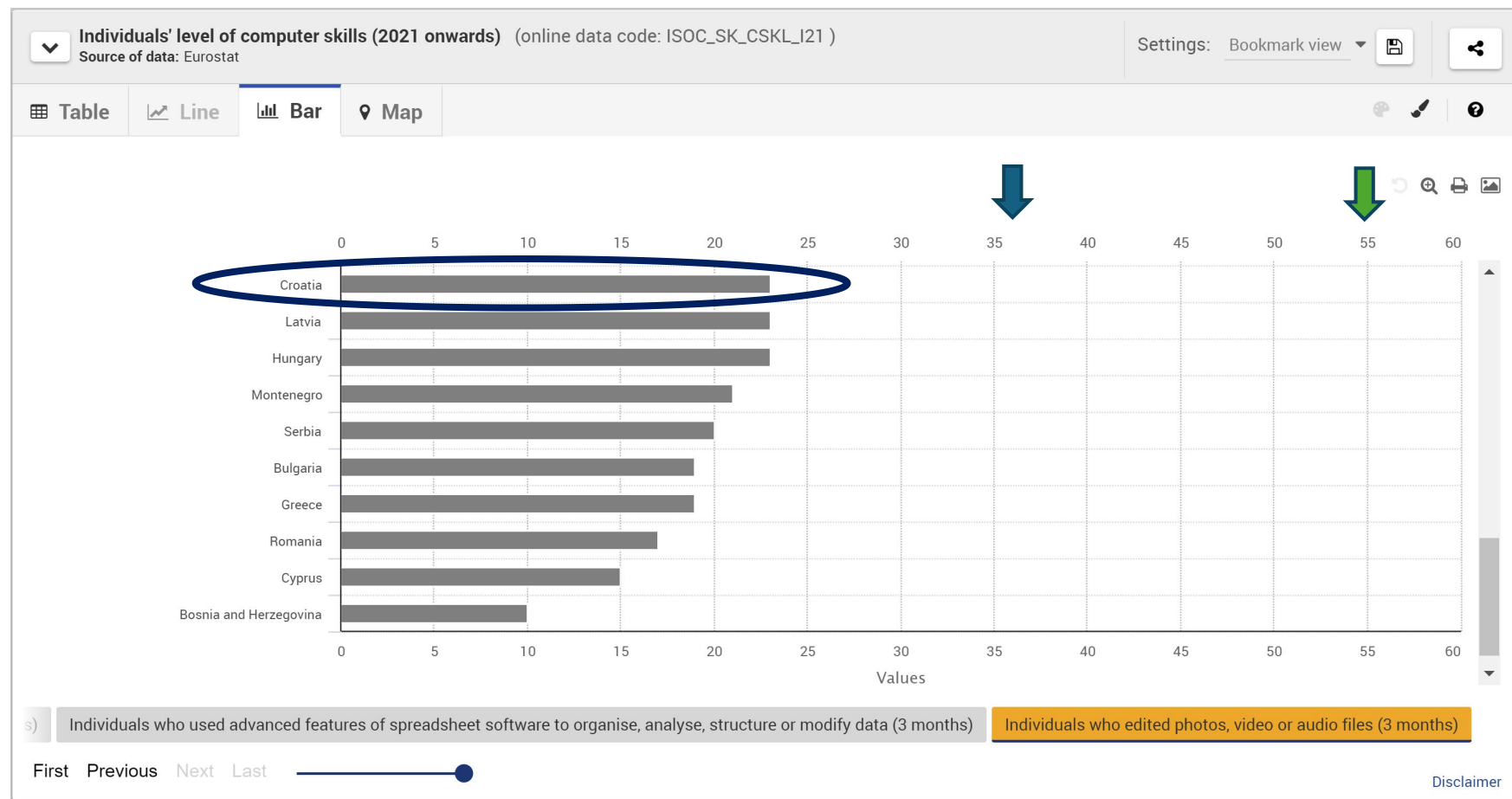


# Gdje je Hrvatska u stvaranju digitalnih sadržaja?



Izvor: Eurostat, ICT usage in households and by individuals (isoc\_i) za 2021.

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Izvor: Eurostat, ICT usage in households and by individuals (isoc\_i) za 2021.

# **„Avangarda“ iz 2019 (prije 5 godina)**

# Primjer 2. – ispiti i prepisivanje (2019)

Studenti očekuju da je prepisivanje „normalna pojava”.

Mi vjerujemo da obrazovna ustanova treba razvijati osobnu odgovornost i vjerujemo kako svatko treba zaslužiti svoju ocjenu na temelju rezultata.

Rješenje 1 Vanjski ispitivači - studenti.

Rješenje 2 Vanjski ispitivači – umirovljeni profesori srednje škole + studenti.





# Primjer 5. – Albon (2019)



Ideja

Uvesti matematički model povezan sa Infoedukom unutar kojega se bilježi rezultat rada nastavnika po nizu kriterija. Izračunati broj bodova nastavnika i njime utjecati na cca. 20% iznosa satnice. Prikazivati rezultat u realnom vremenu na sučelju nastavnika.

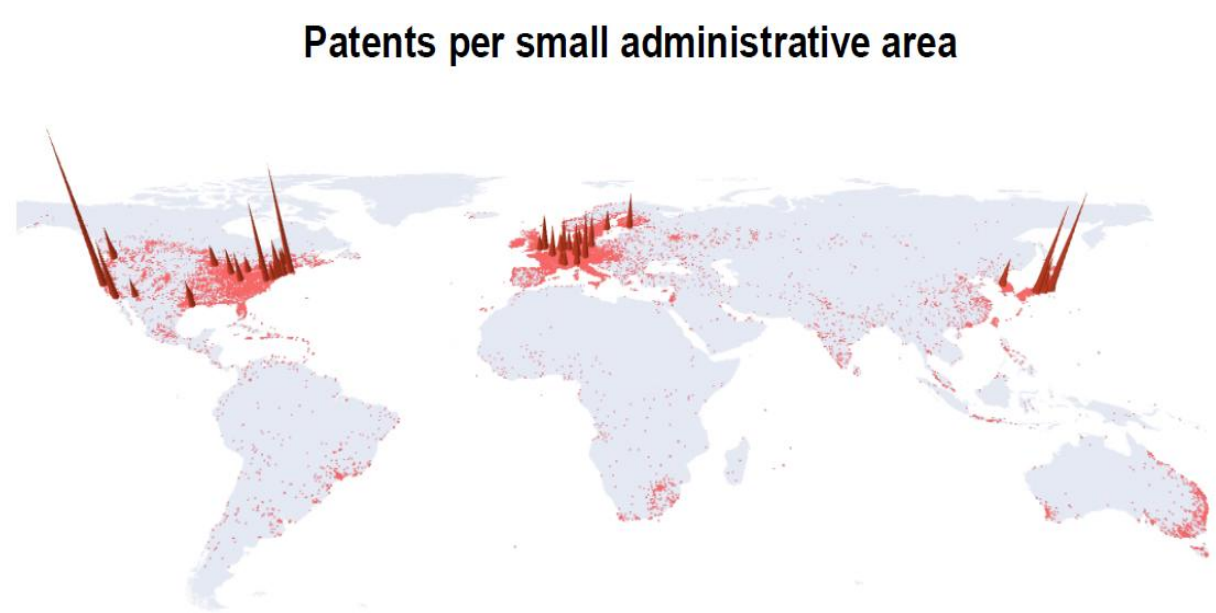
# Što donosi budućnost?

- Razvoj tehnologije i inovacije
- Trenutna/buduća sposobnost digitalne tehnologije
- Mogući odgovori država i njihova utemeljenost
- Naša radna mjesta i eri umjetne inteligencije (AI)
- Što može učiniti obrazovni sustav?

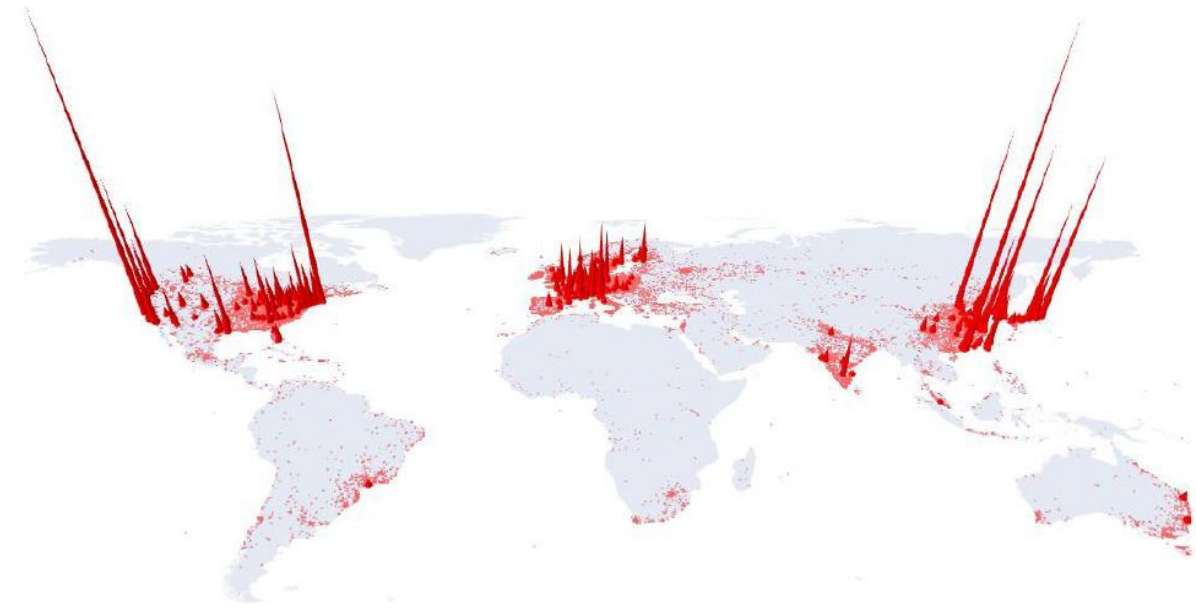


# Znanje i inovacije nemaju „samo jedan“ dom

## Patents per small administrative area



1996-2000



2011-2015

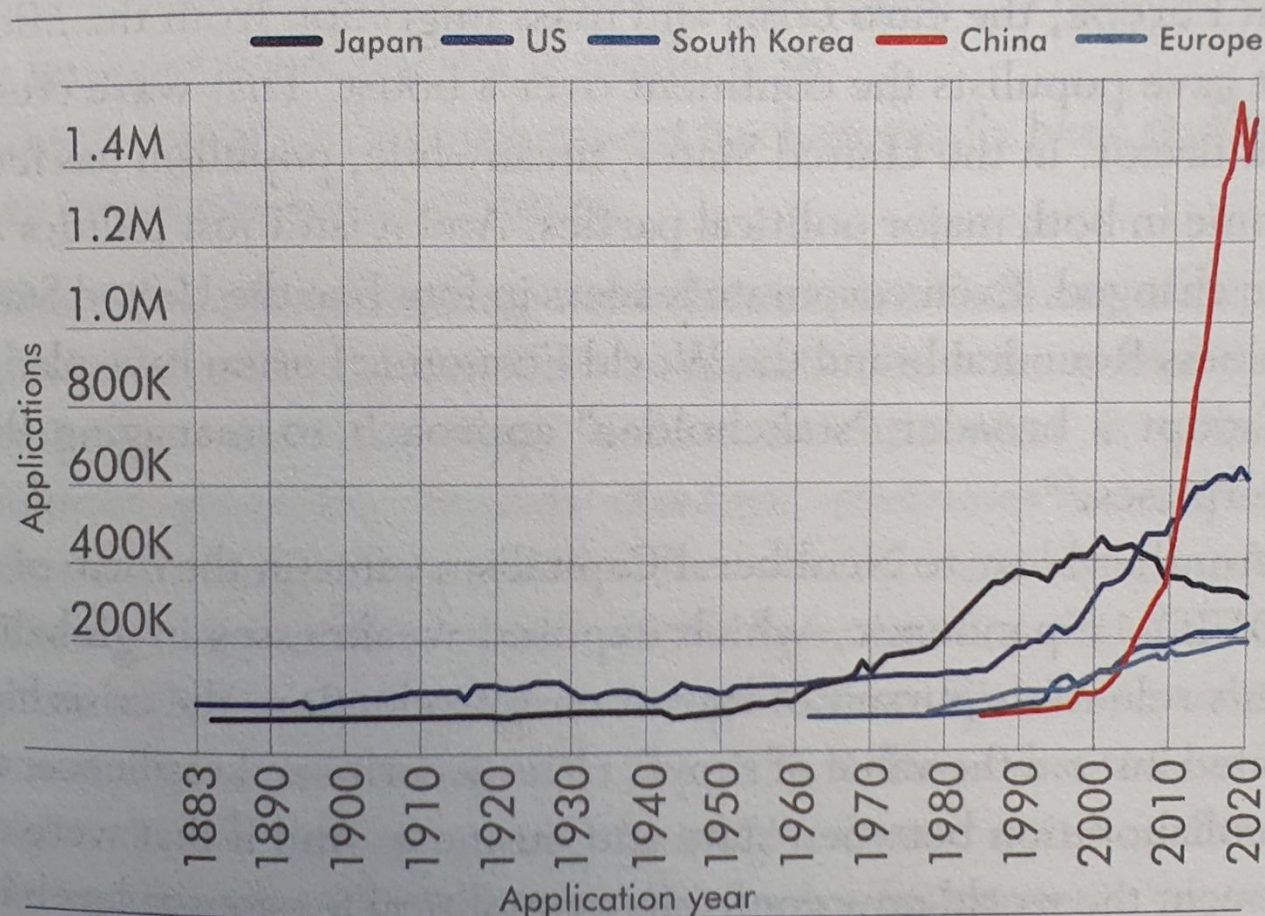
Source: Authors based on PATSTAT, PCT and Web of Science data.



# Što možemo očekivati?

## Trends in patents

Applications in the world's top five offices, 1883-2020



Source: WIPO, Intellectual Property Indicators, The Trilateral Commission

# Što možemo očekivati?

Bill Gates posjeduje bogatstvo koje je oko **1,5 milijuna puta** veće od godišnjeg prihoda prosječne američke obitelji.

Marginalni trošak „proizvodnje“ dodatnog digitalnog proizvoda je često **nula**.

| Rank | Company   | Country     |
|------|-----------|-------------|
| 1    | Google    | USA         |
| 2    | Microsoft | USA         |
| 3    | IBM       | USA         |
| 4    | Amazon    | USA         |
| 5    | Apple     | USA         |
| 6    | Samsung   | South Korea |
| 7    | Tencent   | China       |
| 8    | Intel     | USA         |
| 9    | Siemens   | Germany     |
| 10   | NEC corp. | Japan       |
| 11   | Alibaba   | China       |
| 12   | Facebook  | USA         |
| 13   | Huawei    | China       |
| 14   | Meta      | USA         |
| 15   | Qualcomm  | USA         |

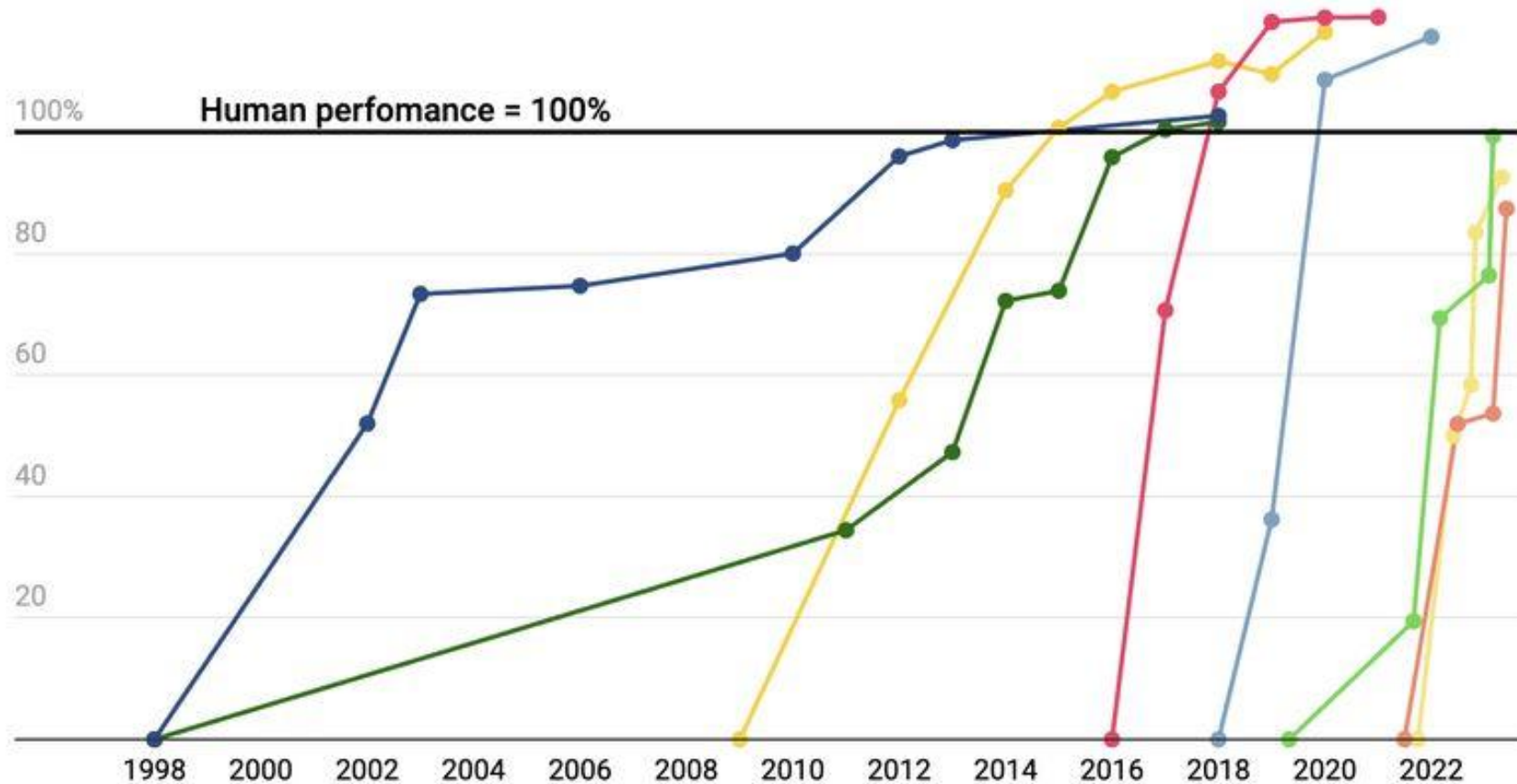
Source: Center for Security and Emerging Technologies, PARC, The Trilateral Commission



# AI has surpassed humans at a number of tasks and the rate at which humans are being surpassed at new tasks is increasing

State-of-the-art AI performance on benchmarks, relative to human performance

- Handwriting recognition
- Speech recognition
- Image recognition
- Reading comprehension
- Language understanding
- Common sense completion
- Grade school math
- Code generation




For each benchmark, the maximally performing baseline reported in the benchmark paper is taken as the "starting point", which is set at 0%. Human performance number is set at 100%. Handwriting recognition = MNIST, Language understanding = GLUE, Image recognition = ImageNet, Reading comprehension = SQuAD 1.1, Reading comprehension = SQuAD 2.0, Speech recognition = Switchboard, Grade school math = GSK8k, Common sense completion = HellaSwag, Code generation = HumanEval.

Chart: Will Henshall for TIME • Source: ContextualAI

# Što države čine da pripreme mlade za takvu budućnost ?

## Digital Education



**DIGITAL WORLD**  
a new subject introduced in elementary schools


integrated software records education facilities, programs, students, teachers, budgets, enrollment rates and employment success

Serbia is one of the first countries in the world to introduce coding as mandatory subject in elementary schools.


- 01
- 02
- 03
- 04

**1<sup>th</sup> GRADE**  
7-year old's learn the basis of algorithm thinking

**5%**  
of all informatics and computing, engineering and technology courses modules on the foundations of artificial intelligence



## Digital Education



**DIGITAL WORLD**  
a new subject introduced in elementary schools

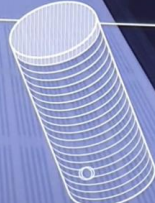
integrated software records education facilities, programs, students, teachers, budgets, enrollment rates and employment success

Serbia is one of the first countries in the world to introduce coding as mandatory subject in elementary schools.


- 01
- 02
- 03
- 04

**6<sup>th</sup> GRADE**  
elementary school children learn python

**5%**  
of all informatics and computing, engineering and technology courses modules on the foundations of artificial intelligence



## Digital Education



**DIGITAL WORLD**  
a new subject introduced in elementary schools

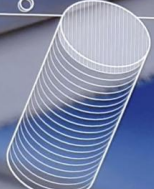
integrated software records education facilities, programs, students, teachers, budgets, enrollment rates and employment success

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**1,000**  
high school students annually take specialized IT classes including database programming, web programming and AI

**5%**  
of all informatics and computing, engineering and technology courses modules on the foundations of artificial intelligence

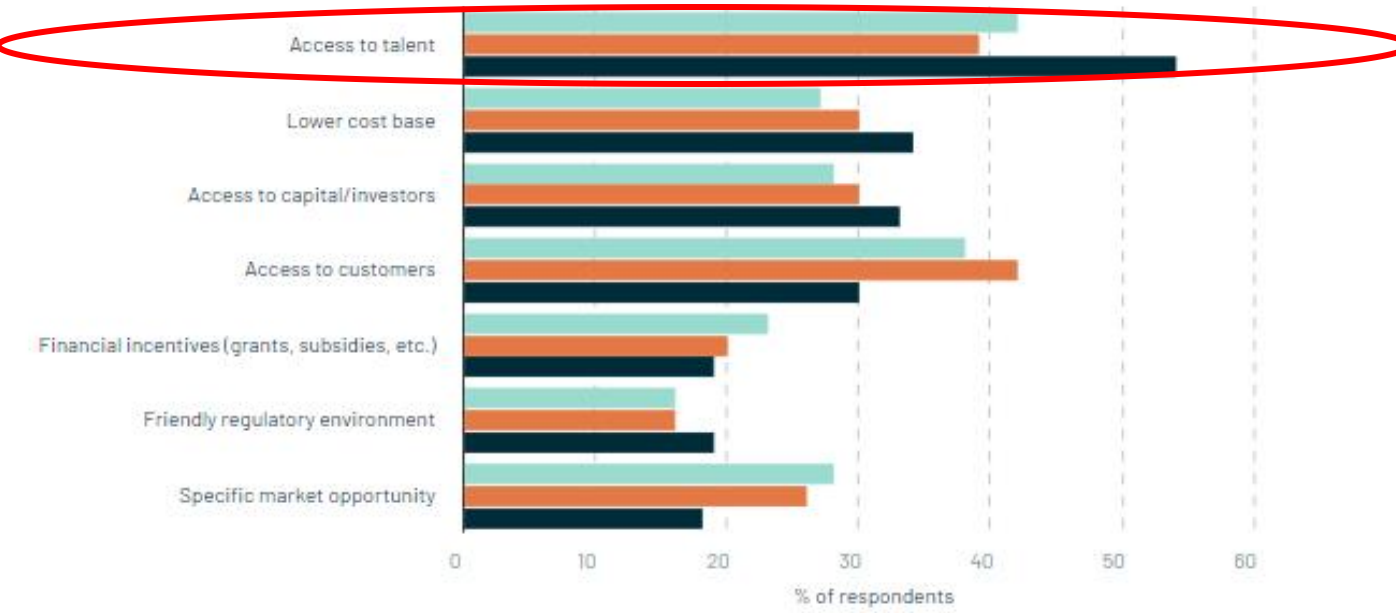


# Zašto je to važno?

What were the most important practical business considerations for you when choosing where to locate your company when you founded it?

- LEGEND
- First-time founder
  - Repeat founder with limited experience in scaling company
  - Repeat founder with significant experience in scaling company

NOTE:  
Founder respondents only. Numbers do not add to 100 as respondents could choose multiple responses.



SOURCE: The State of European Tech Survey

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## Potencijalni **rizici** koji mogu ugroziti radna mjesta

- Digitalizacija je povećala produktivnost (i plaće) za oko 35% **samo u 5% najboljih tvrtki** dok je produktivnost rasla samo 5% u preostalih 95% tvrtki.
- Oko **80%** zanimanja **neće** biti izmijenjeno od strane AI **za više od 20%** aktivnosti, dok će oko 20% zanimanja doživjeti automatizaciju 50% aktivnosti.
- Danas mnogi više i ne pomišljaju plaćati prevoditelje kad Google ili Microsoft besplatno taj posao odrađuju prilično dobro i svakim su danom sve bolji.
- Sutra će biti automatizirani poslovi u području računovodstva, prava, dijela dijagnostike u medicini...
- Strojevi će postati **suradnici u radu**, dogodit će se **nova podjela rada** u značajnom postotku zanimanja



## Prilike koje donosi obrazovanje budućnosti

AI preispituje koncept „comparative labor advantages” kako ga razumije ekonomska literatura (Samuelson & Nordhaus, 2009).

**Različito vrijeme učenja za različito zanimanje** (kvalifikaciju).

Tipično vrijeme obrazovanja za neko zanimanje je prediktor zarade (Adam Smith, 1776).

Umjetna inteligencija (AI) ruši relaciju između vremena učenja i plaće = za neke poslove nije se isplativo školovati

Obrazovanje se mora fokusirati na interpersonalne vještine u odnosu na činjenice i ekspertizu koja se na njima temelji i „**prihvatiti**” postojanje tehnologije

Sve će manje ljudi raditi iako će produktivnost i dobit kompanija za to vrijeme sve više rasti. Treba zato mudro birati znanja i sektore.

"Ako smo naučili išta iz povijesti ekonomskog razvoja, to je da **kultura** čini gotovo svu razliku."

David S. Landes, Harvard University  
*The Wealth and Poverty of Nations, 1995.*