Trials and Tribulations of A "High-Level" Kind
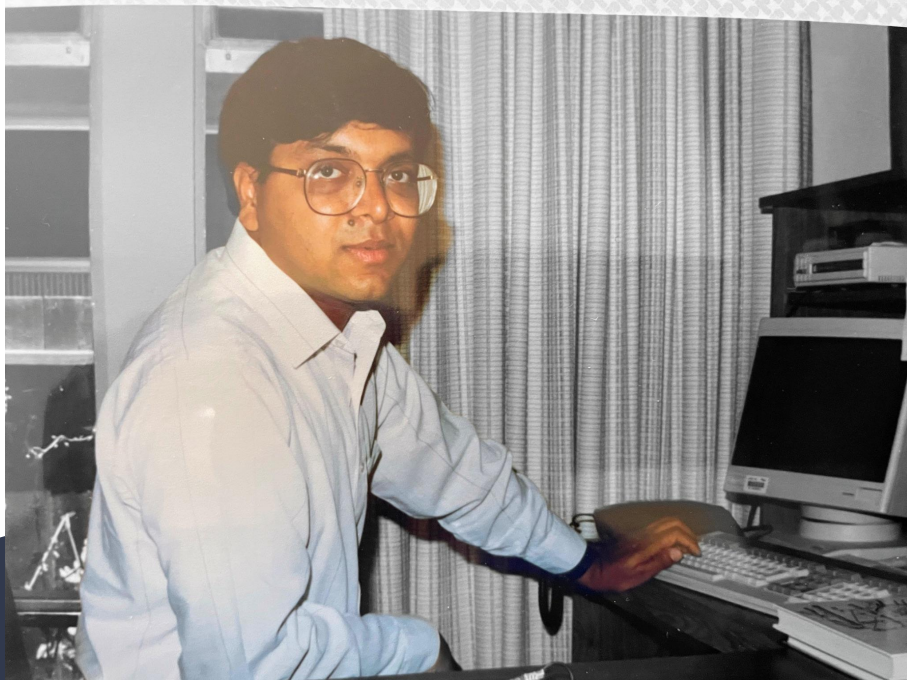

Rajesh K Gupta
UC San Diego.
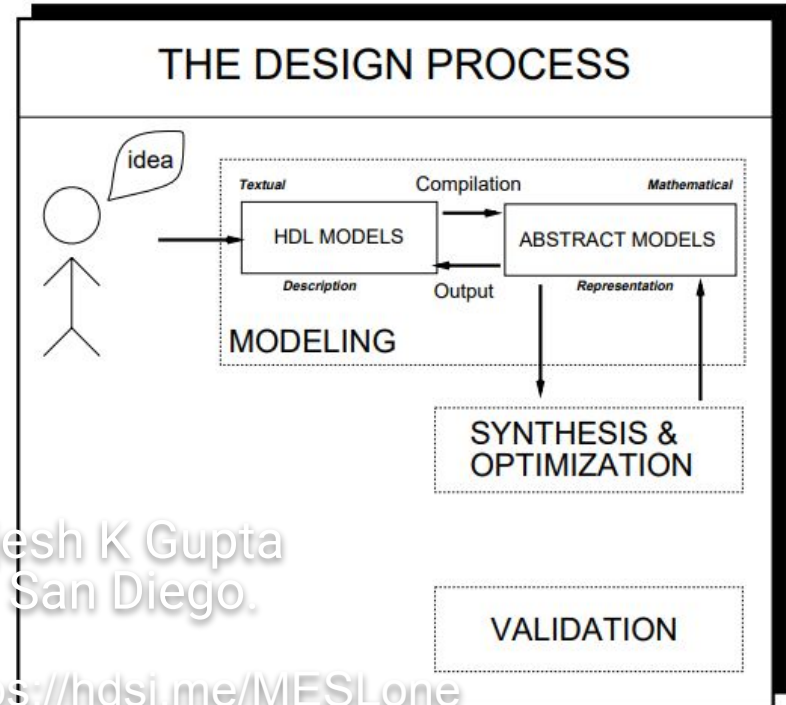
https://hdsi.me/MESLone

https://bit.ly/GuptaNanni2024

Trials and Tribulations of A "High-Level" Kind

Rajesh K Gupta
UC San Diego.

https://hdsi.me/MESLone

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Ku and Frey's Kingdom of Olympus, SIF and SLIF


```
process counter(a,b,c)
    in port a[8];
    in channel b[8];
    out port c[8];
{
    boolean x[8], y[8], z[8];

    x = read(a);
    y = receive(b);

    if (x > y)
        z = x - y ;
    else
        z = x * y;

    while (z >= 0) {
        write c = y;
        z = z - 1;
    }
}
```
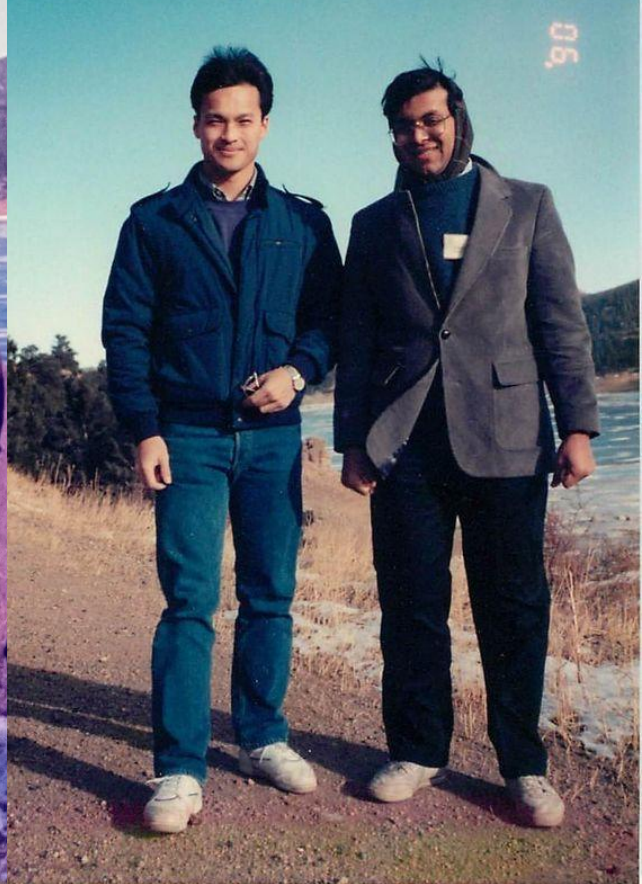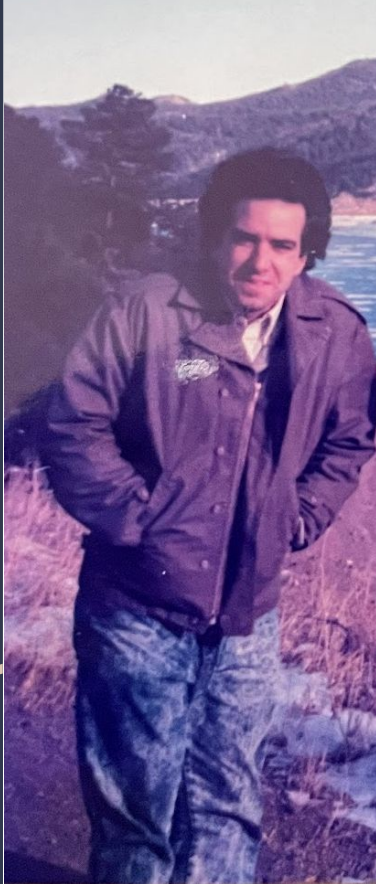
Ku and Frey's Kingdom of Olympus, SIF and SLIF
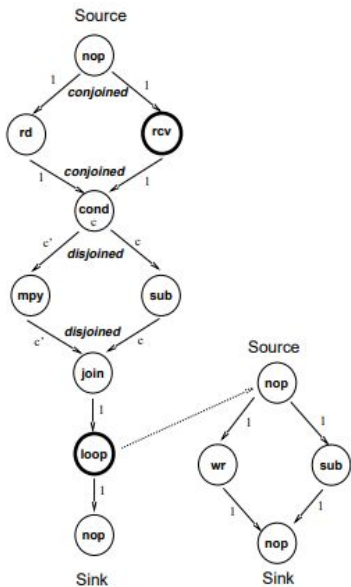

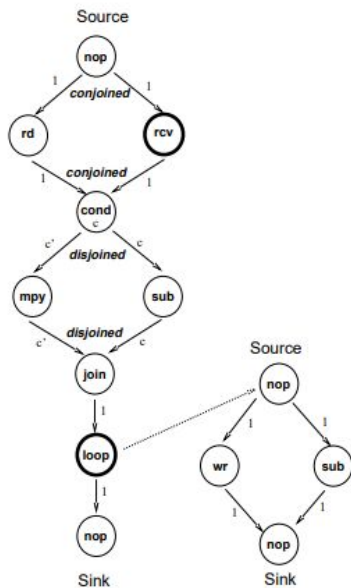
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```


From HLL to HDL: Semantic Needs

MID 1980,s

☐ Concurrency
- model hardware parallelism, multiple clocks

EARLY 1990,s
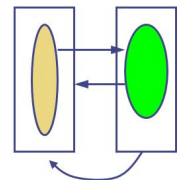
☐ Timing Determinism
- ☐ provide a "predictable" simulation behavior

EARLY 2000,s
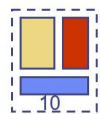
☐ Reactive programming
- provide mechanism to model non-terminating interaction with other components, watching, waiting, exceptions

MID 2000,s

☐ Structural Abstraction
- provide a mechanism for building larger systems by composing smaller ones

10

Ku and Frey's Kingdom of Olympus, SIF and SLIF
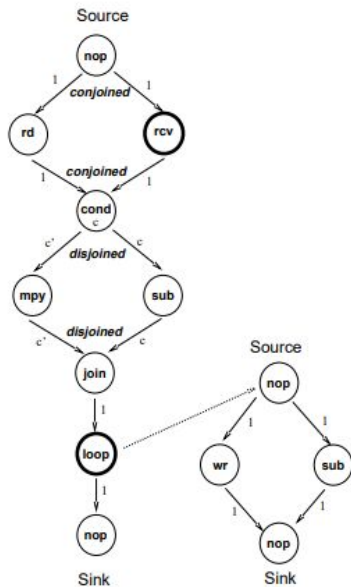


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    while (z >= 0) {
        write c = y;
        z = z – 1;
    }
}
```



```
sif.a – SIF parser and manipulation routines

Parser:

        sif_model *       SIF_READ(filename)
                          SIF_WRITE(fp, sif_model)
                          SIF_FREE( & sif_model )

Utility:

                          SIF_NUMBER(sif_model)
                          int SIF_FLATTEN(sif_model, isprint)
                                  SIF_FLATTEN_body(body)
                          int SIF_REDUCE(sif, isprint)
                          SIF_PURGE(sif_model)
                          SIF_DELAY(sif_model, cycletime, isprint)
                                  int SIF_DELAY(body, cycletime,isprint)
                          SIF_NODELINK(sif_model)
                          SIF_SUMMARY(fp, sif_model)
                          SIF_LOGIC_ESTIMATE(sif)
                          LOGIC_ESTIMATE(delay, area, eqs, outlist)
                          SIF_FLATNAME(sif)

                          char * DELAY_UNIT(unit)
                          char * AREA_UNIT(unit)

Timing constraints:

        tim_model *       TIM_EXTRACT(sif_model, instName)
                          TIM_APPLY(sif_model, tim_model)
                          TIM_PURGE(sif_model)
                          TIM_RESOLVE_TAG(sif_model)

Dependency constraints:

        dpd_model *       DPD_EXTRACT(sif_model, instName)
                          DPD_APPLY(sif_model, dpd_model)
                          DPD_PURGE(sif_model)
                          DPD_REDUCE(sif_model)
                          DPD_REDUCE_body(sif_body)

Resource constraints:

        res_model *       RES_EXTRACT(sif_model, instName)
                          RES_APPLY(sif_model, res_model)
                          RES_PURGE(sif_model)

Scheduling constraints:

        sch_model *       SCH_EXTRACT(sif_model, instName)
                          SCH_APPLY(sif_model, sch_model)
                          SCH_PURGE(sif_model)
```
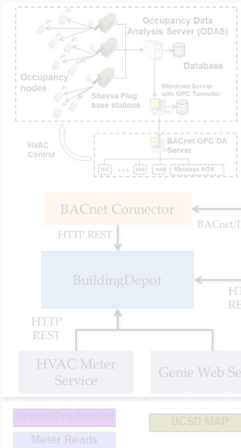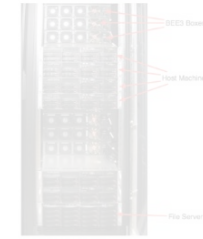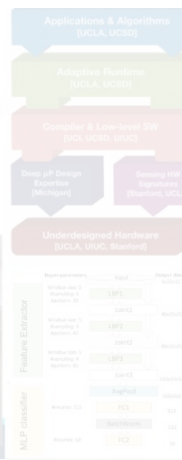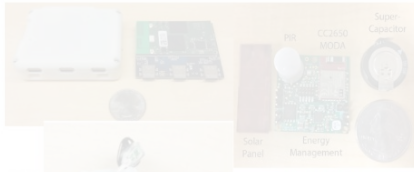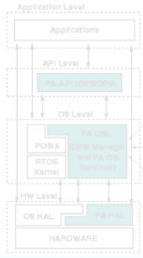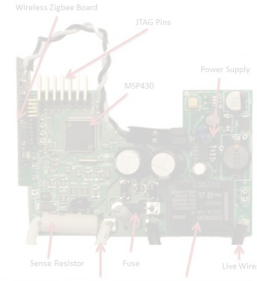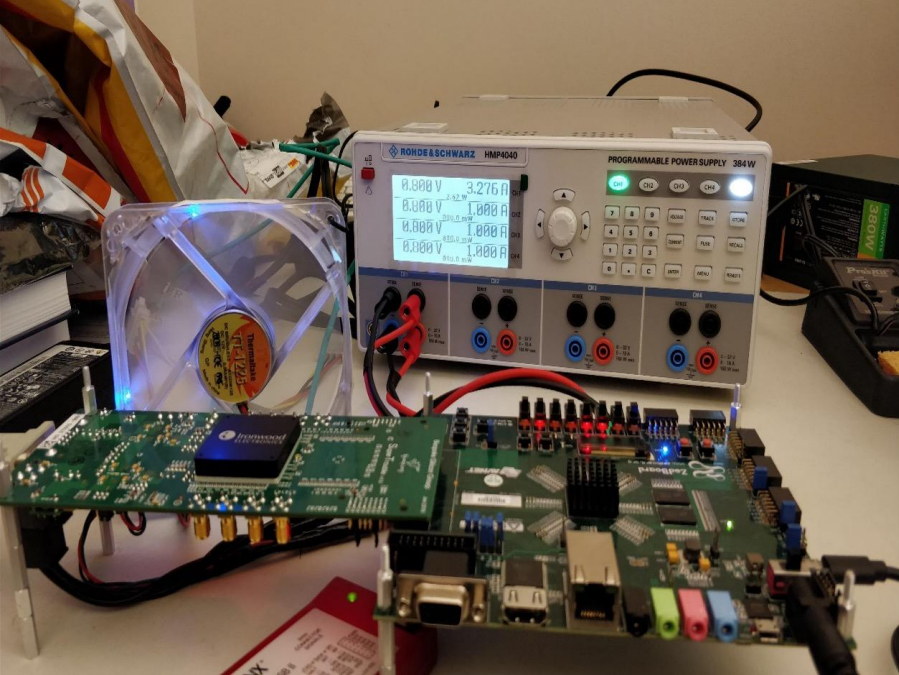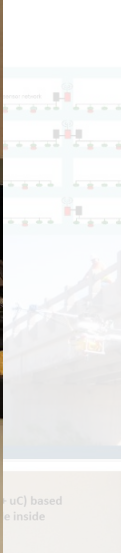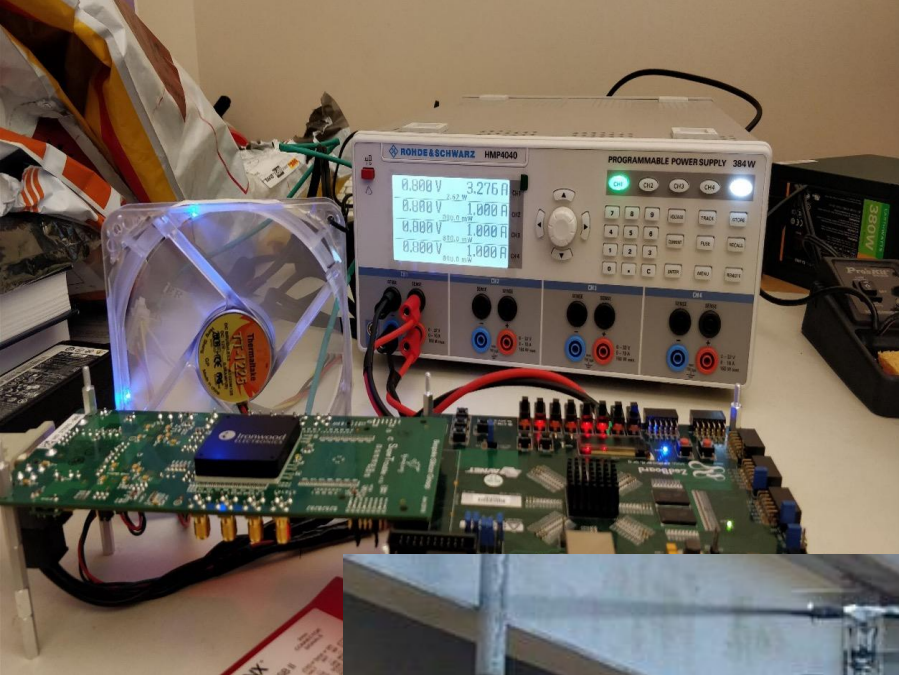
Build and Deploy: Chips, Systems and Systems of Systems.

Build and Deploy: Chips, Systems and Systems of Systems.

Build and Deploy: Chips, Systems and Systems of Systems.
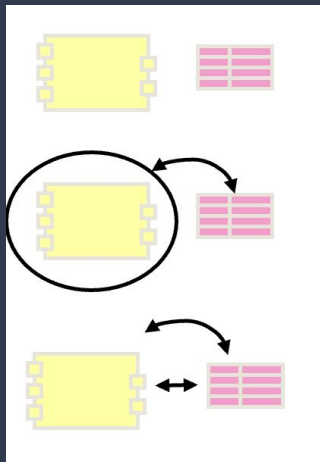
Life Lesson: Context & Subtext Matter

Those who understood the context...

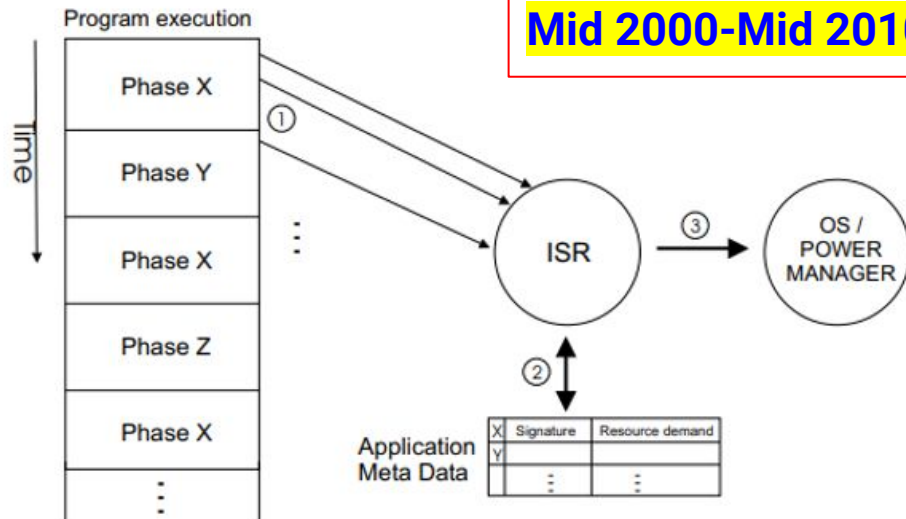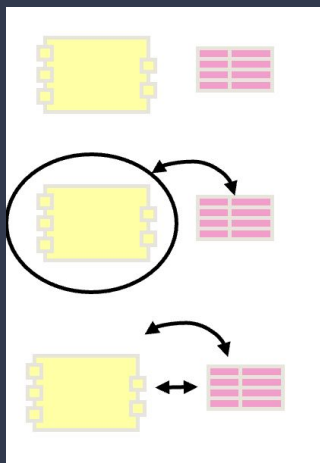and the subtext of life around us...did well.
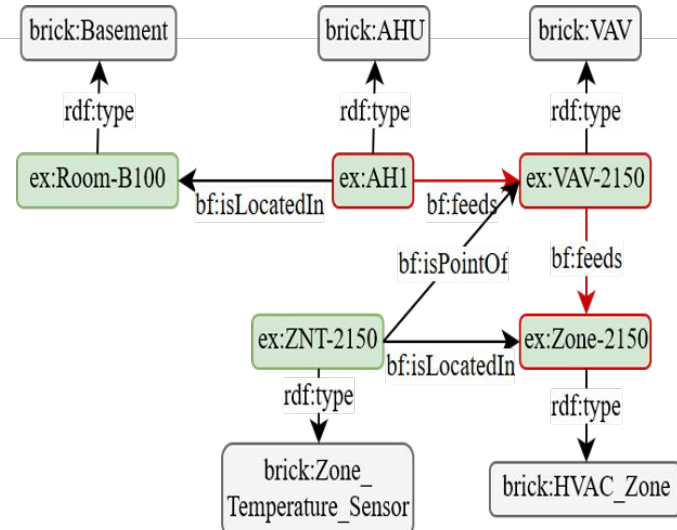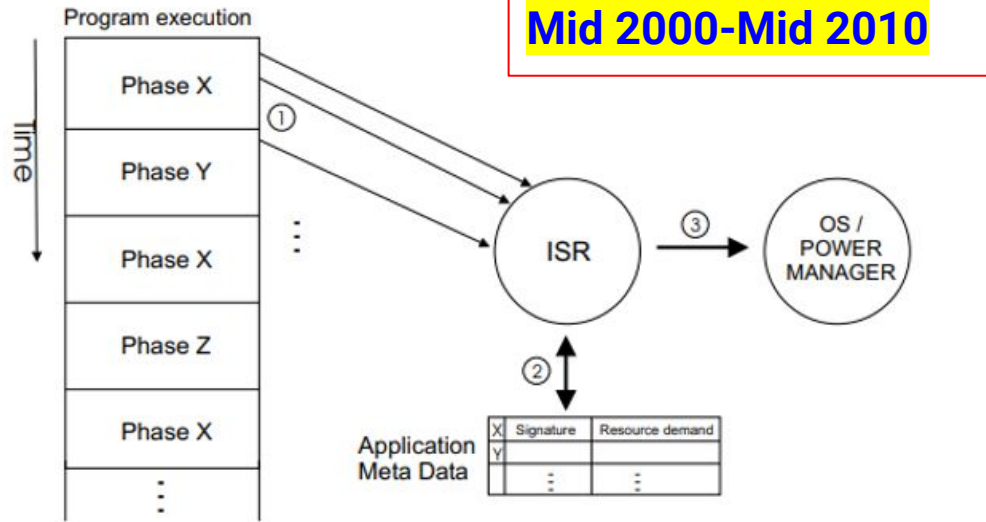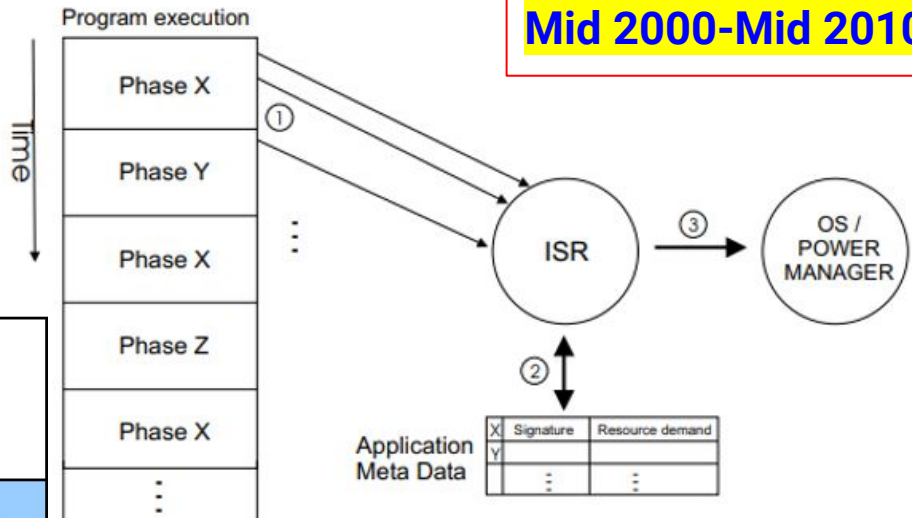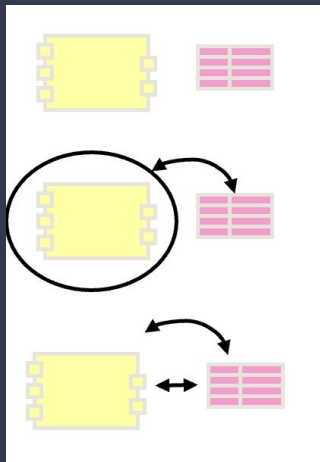
Very well.

Reflection and Introspection

Reflection and Introspection

Reflection and Introspection
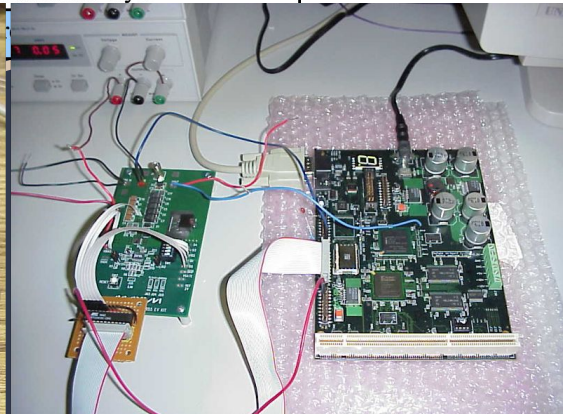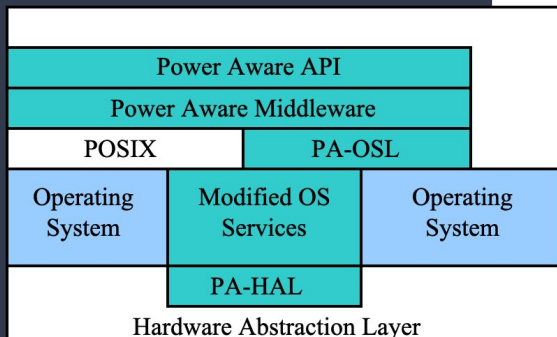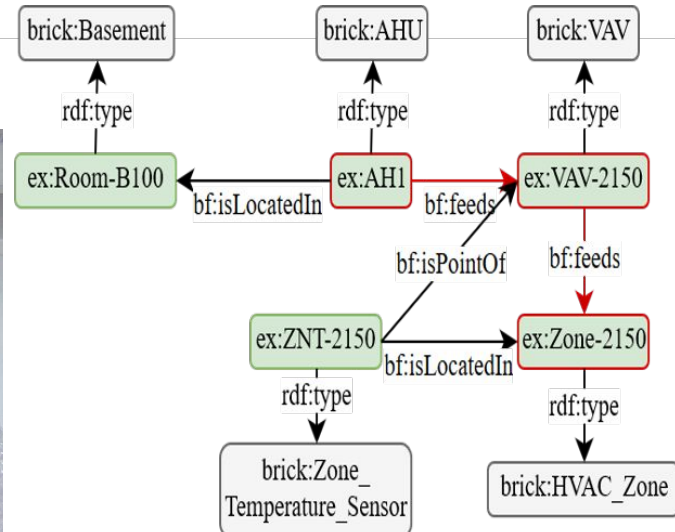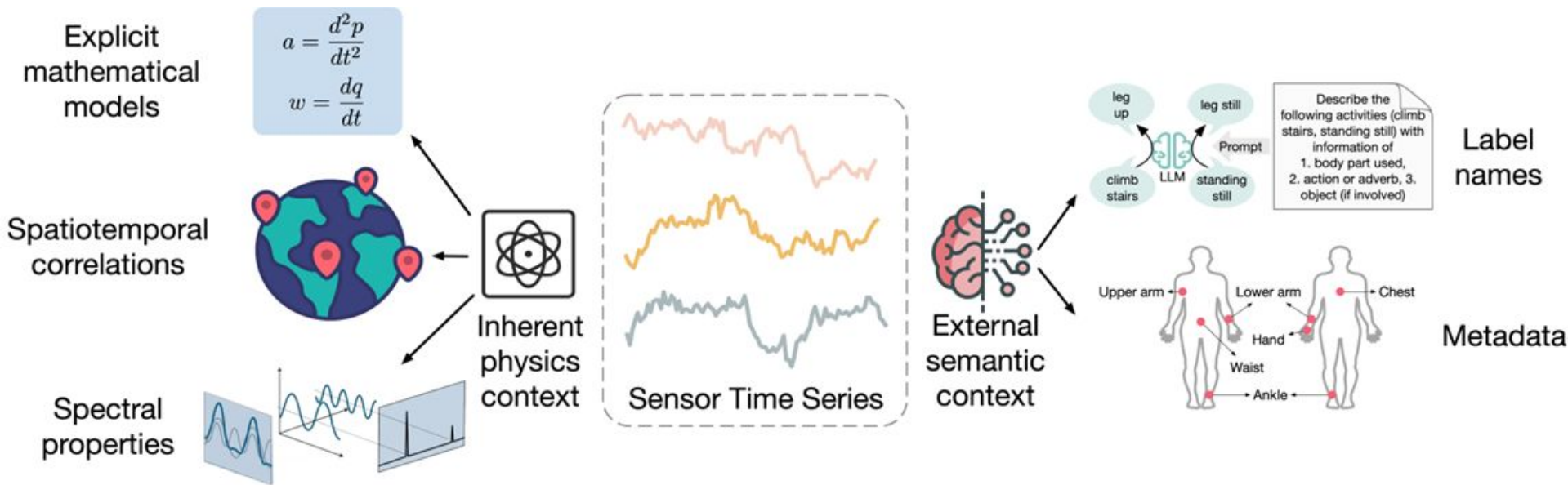
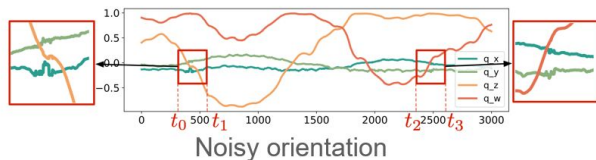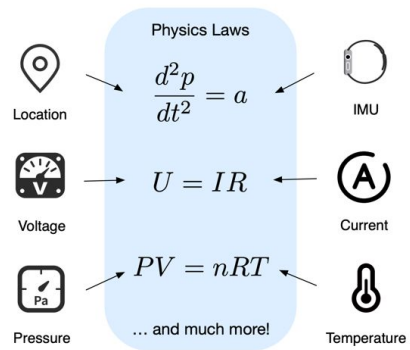Understand and Use Context in Sensing: Physics, Sociological

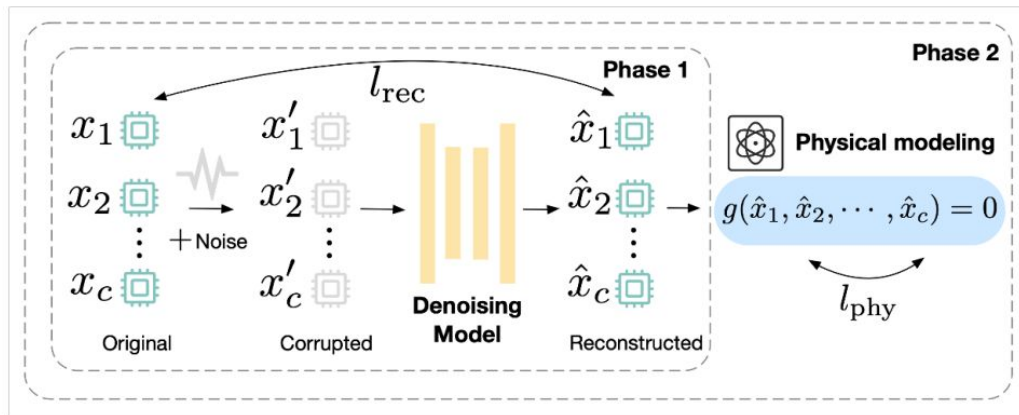# Using Known Physics to Improve Quality (de-noise)

Physics Laws

Location

$$\frac{d^2 p}{dt^2} = a$$

IMU

$$U = IR$$

Voltage

Current

$$PV = nRT$$

Pressure

... and much more!

Temperature

Noisy orientation

Angular velocity can be inferred from orientation data or directly measured by a gyroscope.

Physics equation misalignment
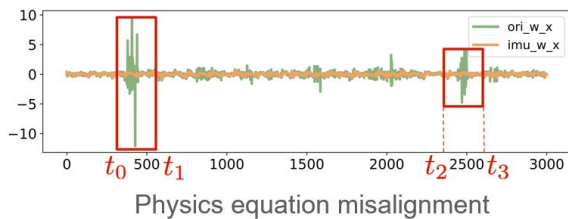
Physics-Informed Machine Learning for Real-Life Sensing Systems, SenSys'23

l_{rec} **Phase 1** **Phase 2**

x_1 x'_1 $\hat{x}_1$ **Physical modeling**

x_2 x'_2 $\hat{x}_2$ $g(\hat{x}_1, \hat{x}_2, \cdots, \hat{x}_c) = 0$

x_c + Noise x'_c $\hat{x}_c$ l_{phy}

Original   Corrupted   **Denoising Model**   Reconstructed

18

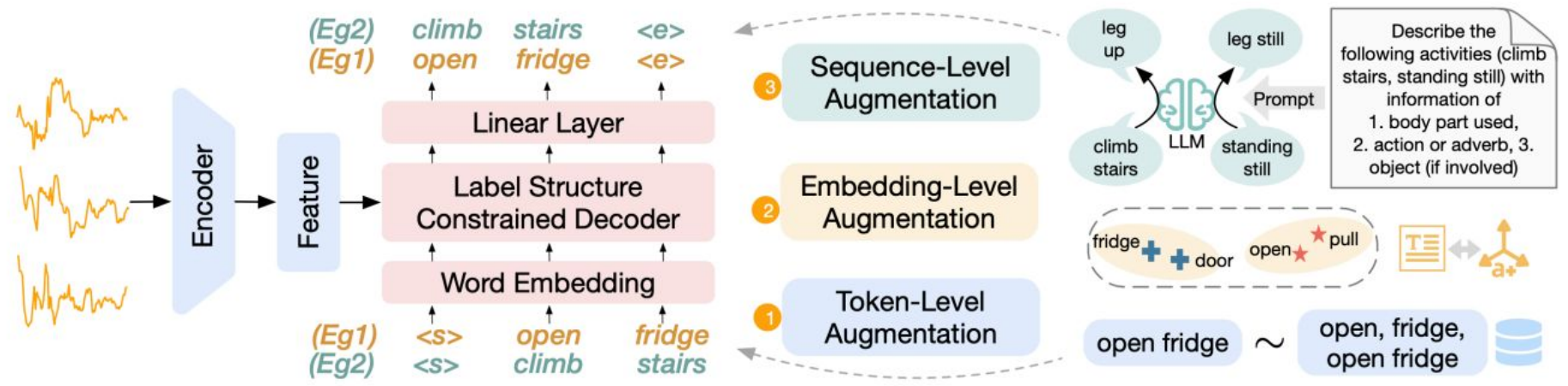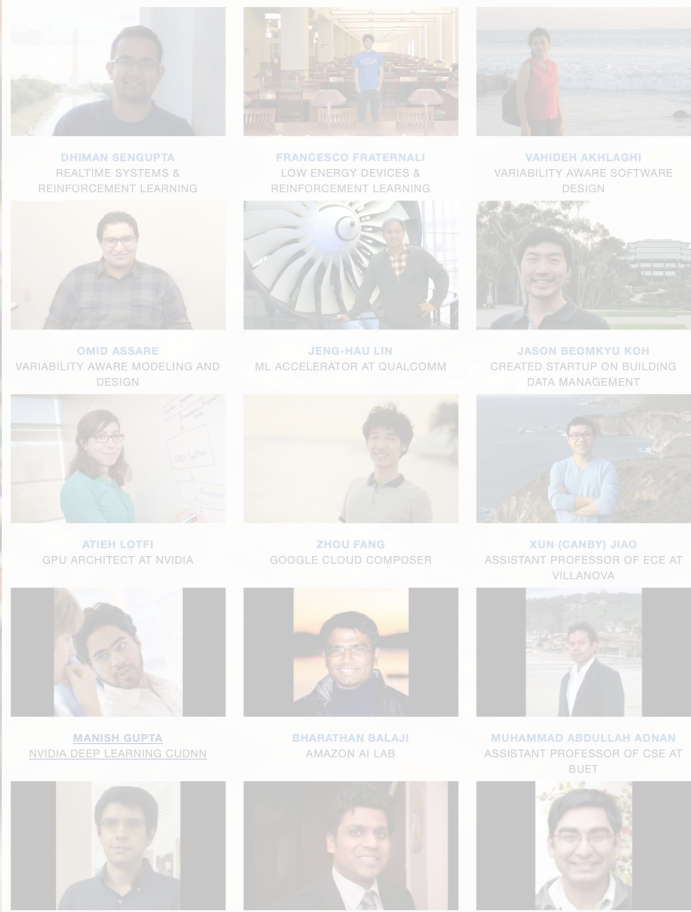# Sensor Talk
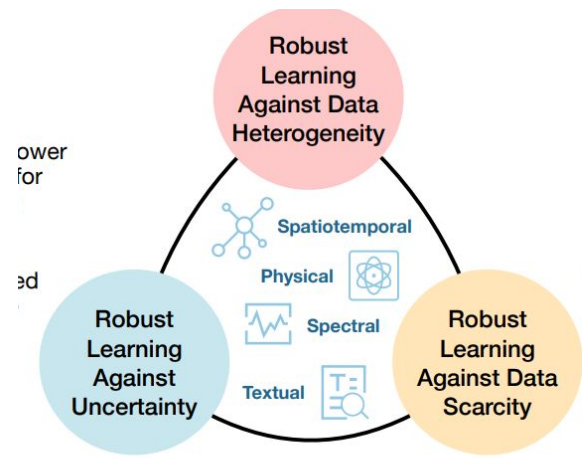
Context-Aware Learning for Robust Sensing Syster

DHIMAN SENGUPTA
REALTIME SYSTEMS & REINFORCEMENT LEARNING

FRANCESCO FRATERNALI
LOW ENERGY DEVICES & REINFORCEMENT LEARNING

VAHIDEH AKHLAGHI
VARIABILITY AWARE SOFTWARE DESIGN

OMID ASSARE
VARIABILITY AWARE MODELING AND DESIGN
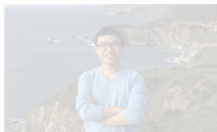
JENG-HAU LIN
ML ACCELERATOR AT QUALCOMM

JASON BEOMKYU KOH
CREATED STARTUP ON BUILDING DATA MANAGEMENT

ATIEH LOTFI
GPU ARCHITECT AT NVIDIA

ZHOU FANG
GOOGLE CLOUD COMPOSER

XUN (CANBY) JIAO
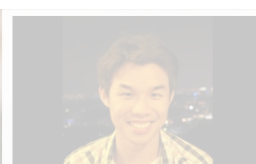ASSISTANT PROFESSOR OF ECE AT VILLANOVA

MANISH GUPTA
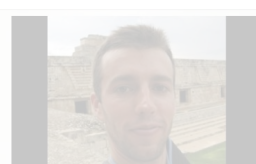NVIDIA DEEP LEARNING CUDNN

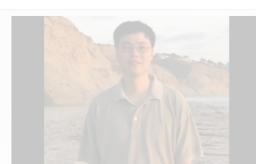BHARATHAN BALAJI
AMAZON AI LAB

MUHAMMAD ABDULLAH ADNAN
ASSISTANT PROFESSOR OF CSE AT BUET

KAISEN LIN
SOFTWARE CONSULTANT

JOEL COBURN
SOFTWARE ENGINEER AT GOOGLE

ZHONG-YI JIN
SOFTWARE ENGINEER AT JOHNSON CONTROL

RYO SUGIHARA
RESEARCH SCIENTIST AT LYFT

SUDIPTA KUNDU
SENIOR R&D ENGINEER AT SYNOPSYS

RAVINDRA JEJURIKAR
LEAD SECURITY ENGINEER AT VERIMATRIX
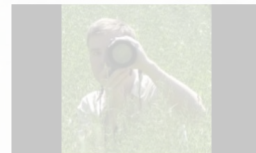
SUMIT GUPTA
LEADS THE AI, ML AND HPC PRODUCTS AT IBM

ALI DASDAN
SENIOR VP OF ENGINEERING AT TURN

JIAN (RAYMOND) LI
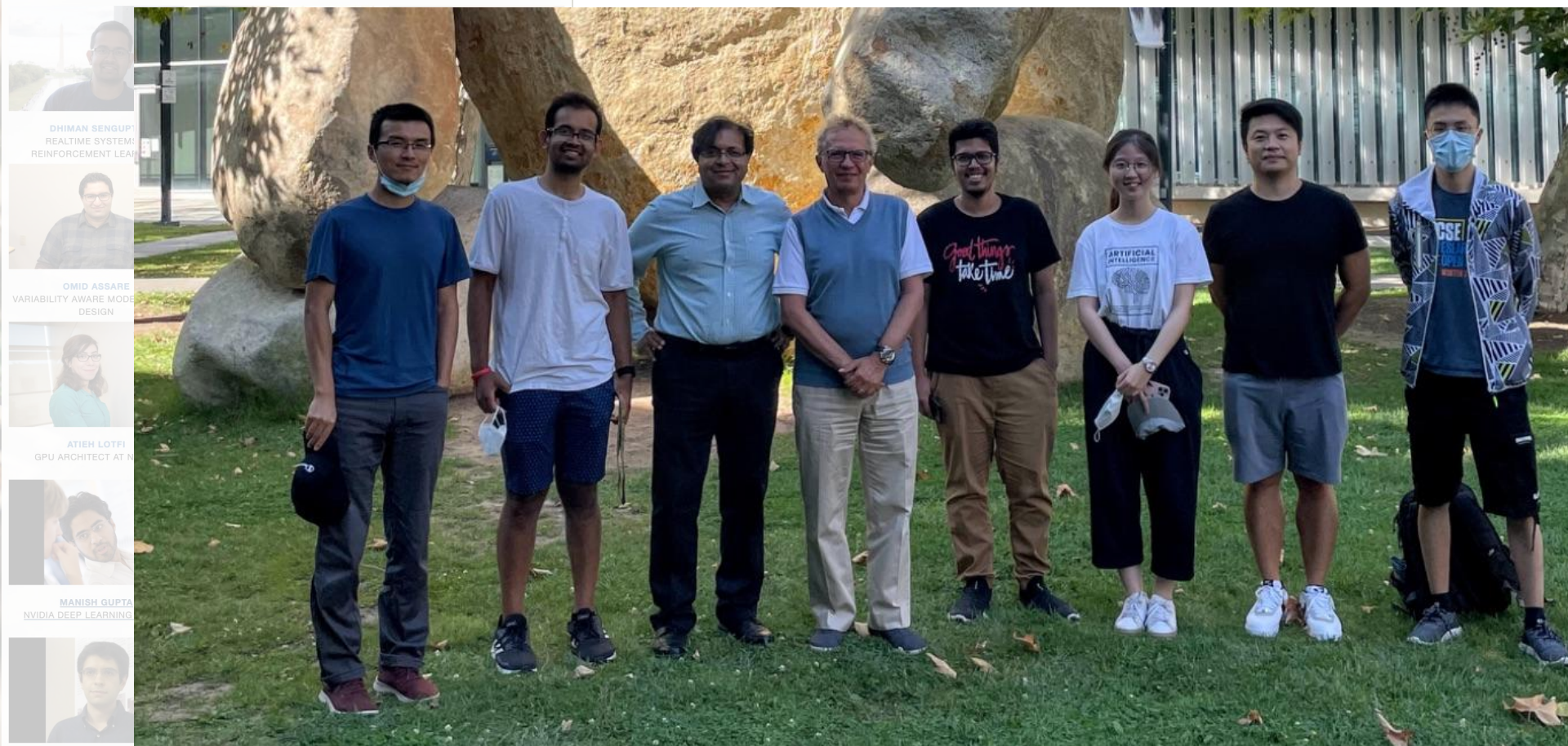BUILDING SOFTWARE THAT POWERS NETWORKING DEVICES

DINESH RAMANATHAN
PRESIDENT AND CEO OF NEXGEN

NICK SAVOIU
MEMBER OF CONSULTING STAFF AT MENTOR GRAPHICS

Thank you, Nanni! For life lessons, and the gift of a friendship!

Thank you, Nanni! For life lessons, and the gift of a friendship!

Th