/ DOOM determines the sky texture to be used depending on the current episode, and the game version skytexture = R\_TextureNumForName ("SKY3"); skytexture = R\_TextureNumForName ("SKY1") If force a wipe gamestate = GS\_LEVEL: if (playeringametii) && playerstiil.playerstate == PST\_DEAD) P\_SetupLevel (gameepisode, gamemap, 0, gameskill); displayplayer = consoleplayer; memset (gamekeydown, O, sizeof(gamekeydown), memset (mousebuttons, 0, sizeof/mpusebuttons wminfo.last = damemap -

// take away cards and stull

// This was quite messy with SPECIAL and commented parts. landom E SAR UN1 ; i<=S\_SARG\_PAIN2 ; i++1 SAR LIAN :-K-S\_SARG\_PAIN2 : i++) stantilic s>=1; rebiefolMT\_\_\_\_\_ISF-\_\_\_prev\_\_20\_\_ccln\_\_1 rebiefolMT\_\_\_\_\_ISF-\_\_\_prev\_\_20\_\_ccln\_\_1 rebiefolMT\_\_\_\_\_ISF-\_\_\_prev\_\_21\_\_cdl1 rebiefolMT\_\_\_\_\_ISF-\_\_\_prev\_\_21\_\_cdl1 rebiefolMT\_\_\_\_\_ISF-\_\_\_prev\_\_21\_\_cdl1 rebiefolMT\_\_\_\_\_ISF-\_\_\_prev\_\_21\_\_cdl1 rebiefolMT\_\_\_\_\_ISF-\_\_\_prev\_\_21\_\_cdl1 rebiefolMT\_\_\_\_\_ISF-\_\_\_prev\_\_21\_\_cdl1 rebiefolMT\_\_\_\_\_ISF-\_\_\_prev\_\_21\_\_cdl1 rebiefolMT\_\_\_\_\_ISF-\_\_\_prev\_\_21\_\_cdl1 rebiefolMT\_\_\_\_\_ISF-\_\_\_\_ISF-\_\_\_\_del2 rebiefolMT\_\_\_\_\_ISF-\_\_\_\_ISF-\_\_\_\_ISF-\_\_\_\_ISF-\_\_\_\_ISF-\_\_\_\_ISF-\_\_\_\_ISF-\_\_\_\_ISF-\_\_\_\_ISF-\_\_\_\_ISF-\_\_\_\_ISF-\_\_\_\_ISF-\_\_\_ISF-\_\_\_ISF-\_\_\_\_ISF-\_\_ISF-\_\_ISF-\_\_\_ISF-\_\_\_ISF-\_\_ playerslil.playerstate = PST\_REBORN: Edge Al formachine true skytexture = R\_TextureNumForName (\*SKY2\*

switch (episode)

G\_DoNewGame () G\_DoLoadGame G DoSaveGame case ga playdeme G\_DoPlayDemo ( break GUNFLASH1 G\_DeCompleted 0 case ga\_victory F\_StartFinale () G\_DoWorldDone () case ga\_screenshot M\_ScreenShot 0; gameaction = ga\_nothing; break case ga\_nothing Intersection of the section of th Wrand build new consistancy check buf = (gametic/ticdup)%6BACKUPTICS; for ti=0 : i<MAXPLAYERS : i++ if (playeringame(i)) // S\_CHAINFLASH1 cmd = &playerslil.cmd if (demoplayback) S\_MISSILEFLASH# check for turbo cheats // check for special buttons for (i=0 ; i<MAXPLAYERS ; i++) if (playeringame[i]) SPR RAL2 22772 6 (MULLES MULL 0.0

// do things to change the game state while (gameaction != ga\_nothing)

switch laameaction

-case ga\_newgam

G\_ReadDemoTiccmd (cmd) G\_WriteDemoTiccmd (cmd):

static char turbomessage[80] extern char \*player\_names14

if (gametic > BACKUPTICS

switch (playersli).cmd.buttons & BT\_SPECIALMASK)

if (players(il.mo)

case BTS\_PAUSE: paused A= 1; if (paused)

break:

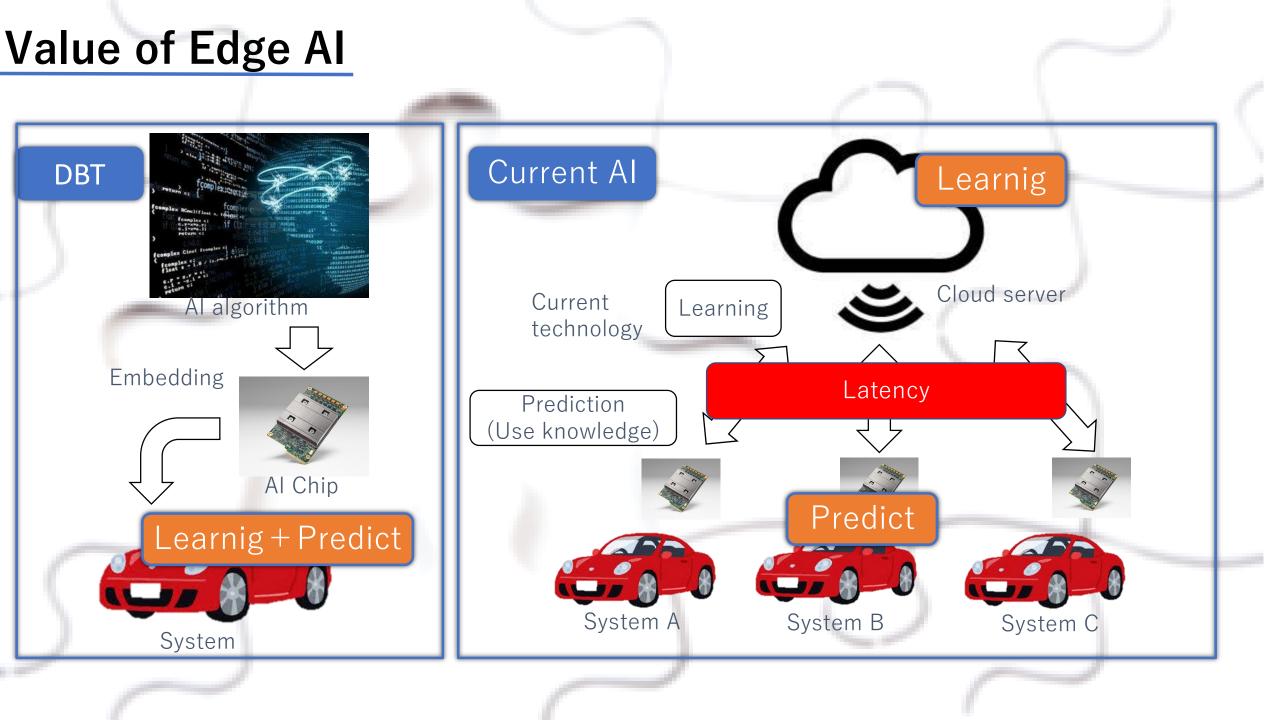
S\_PauseSound 0;

S\_ResumeSound ();

elan

break;

memopy (and, Snetcmdslillbufl, sizeof(ticomd\_t)); && Igametic&31) && (Igametic>>5)&3) == i ) sprintf (turbomessage, "%s is turbo!" player\_names[i]] playerstconsoleplayer1.message = turbomessage; if (netgame && Inetdemo && ((gametic%ticdup) ) && consistancy/illbufl != cmd->consistancy) LError ("consistency failure (%) should be %). emd->consistancy, consistancy[illbufD; consistancy/illbufl = players/il.mo->x; consistancyfillbufl = mdindex if (playerslil.cmd.buttons & BT\_SPECIAL)



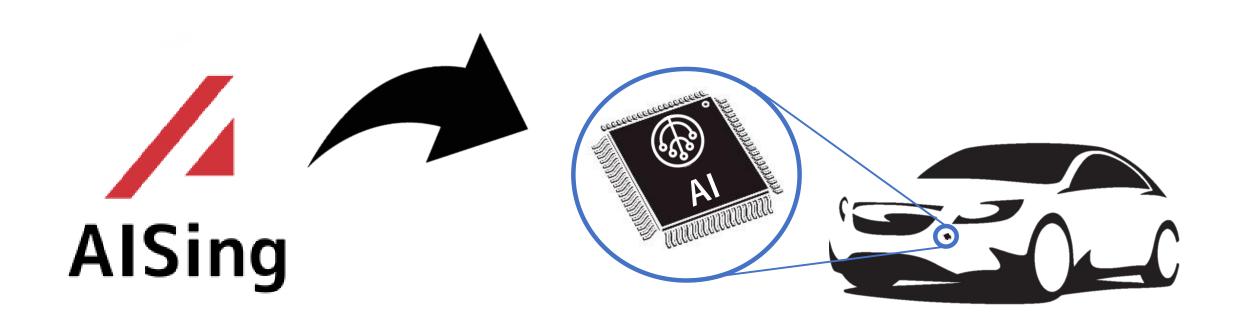
#### Vision

# We make edge devices smarter

# to realize an efficient society

#### **Our business**

# Provide our original AI algorithm license for machine control



### Founders

#### Jun-ichi Idesawa

Graduate form Waseda Univ. Master of mechanical engineering



#### KIM Chyon Hae

Graduate form Waseda Univ. Doctor of mechanical engineering Associate professor at Iwate Univ.

#### **Research AI for machine control**

Over 12 years

#### Problems of traditional machine control

1.Need to make individual control model for accuracy

2.Need to always keeping update the model to keep high accuracy

3.Can only use low performance computer resource

# **Solution**

# Original AI algorithm Deep Binary Tree DBT

- Up-to-date Live training
- Processing on the edge side
- Explainable Al

# **Up-to-date Live training**

Value

Can always keeping update the model so it dose not deteriorate Can make individual control model considering individual differences

#### **Does not deteriorate**



#### **Consider individual differences**



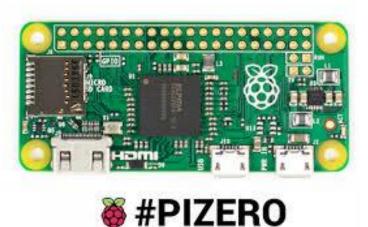
# Processing on the edge side

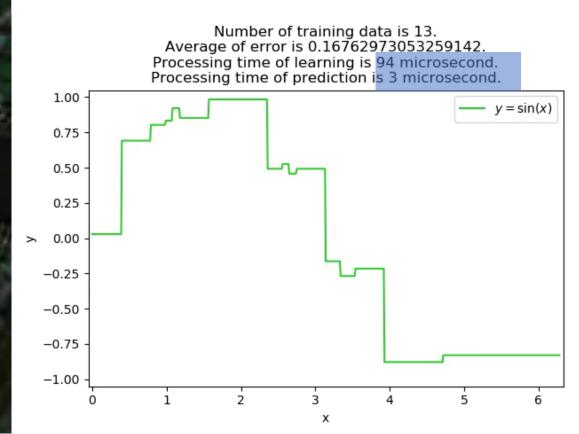
#### Value

#### Never delay the control cycle →The calculation time is constant

#### Low performance computer is available



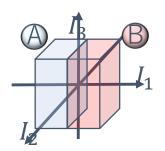


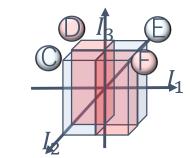


# Explainable Al

#### Single tree structure

#### Can explain why the output was (Answer by the width of the input space)





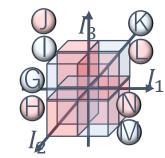
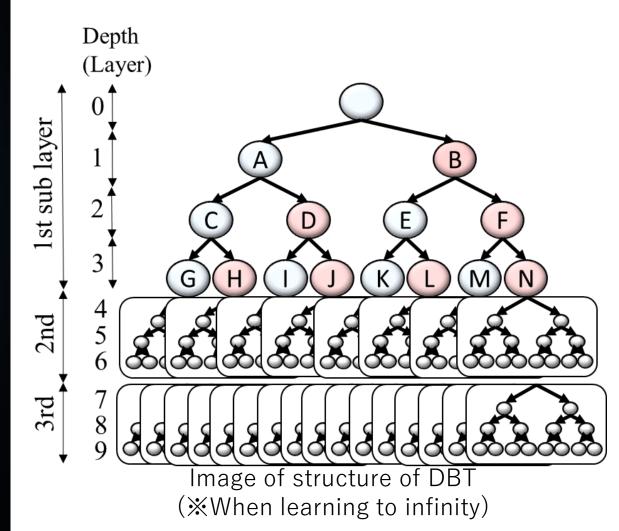
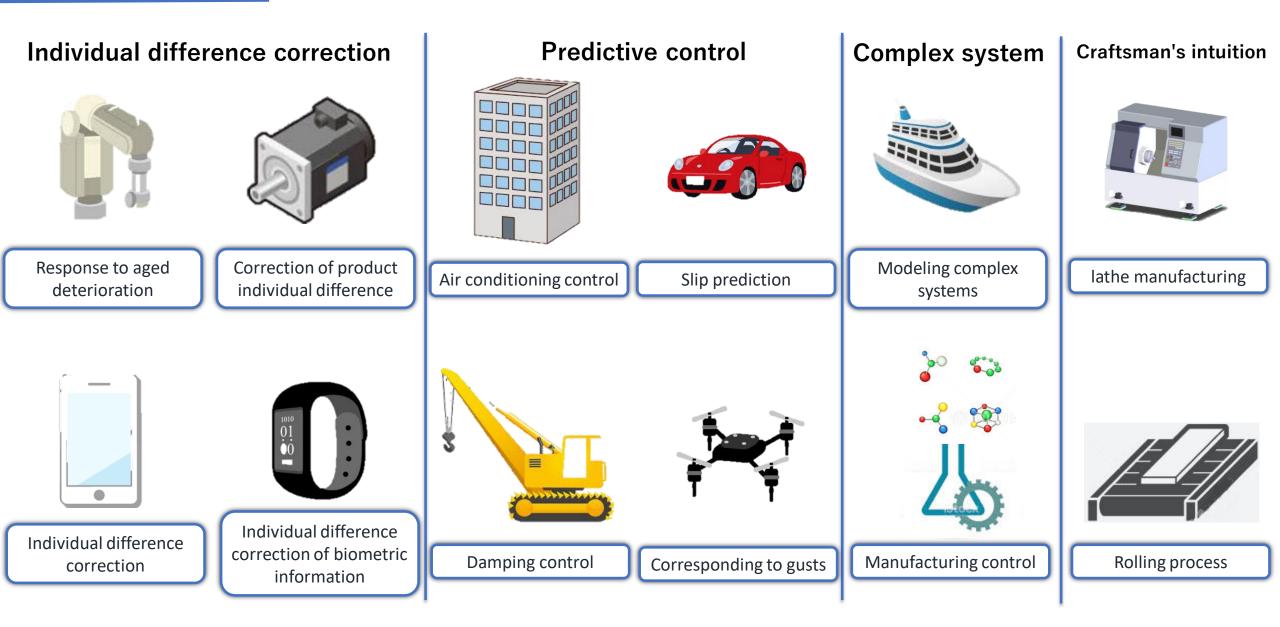


Image of state space assignment



# **Use Cases**



**Disclosable clients** 

OMRON

# Business partnership

Market capitalization: \$10billion





#### Co development about UAV

Market capitalization: \$37billion





#### Co development with about Train

Market capitalization: \$39billion



#### Case 1 : Co-development with OMRON

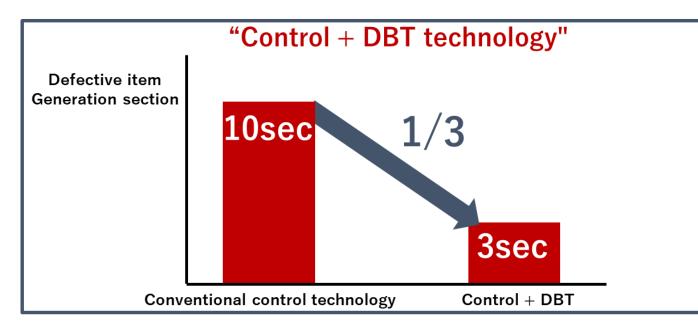
Machine : winding machine (Attach the sheets wound on the reel) Issue : Occurrence of defective product afer changing the real Cause : Vibration of the machine

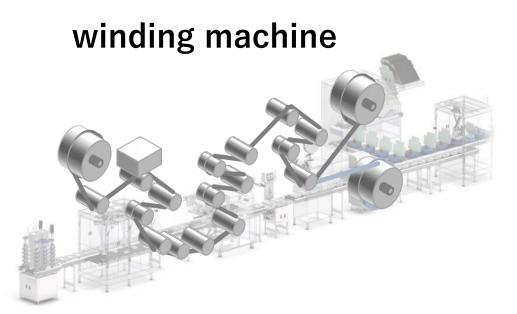
Solution : ①Predict the movement by DeepBinaryTree ② Correct the vibration according to the prediction

Result : Reduce the occurrence of defective products to 1/3

# OMRON







#### Case 2 : Co-development with DENSO

Machine: UAV (6 Drive, Variable pitch mechanism)

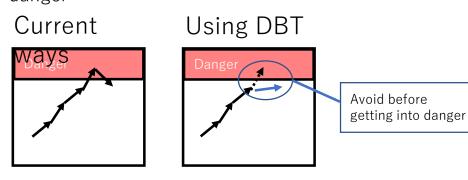
Goal 1 : Risk prediction avoidance Current status : Avoid after reaching dangerous condition Goal 2 : More stable flight Current status : High athletic performance and trade-off stability





#### Goal 1 : Risk prediction avoidance

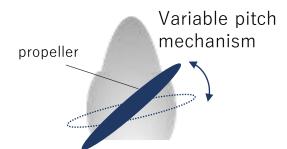
 Future prediction of aircraft inclination with DBT
 Avoid before getting into danger



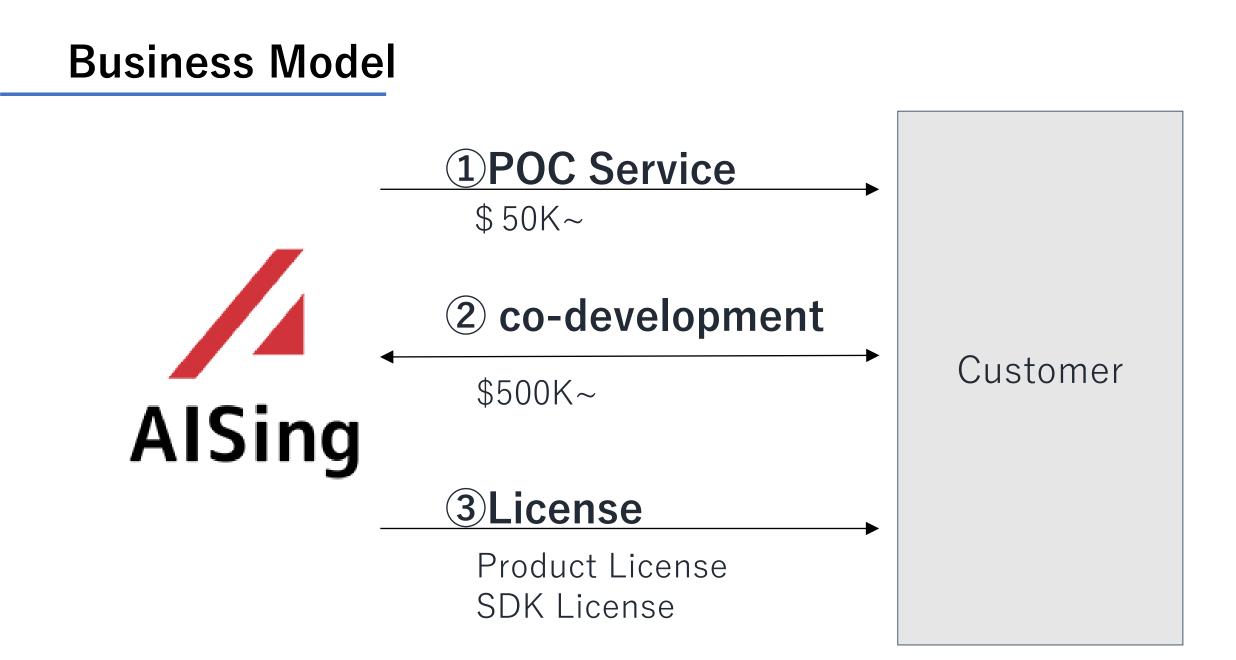
#### Goal 2: More stable flight

DBT predicts change in motion due to change in pitch angle Predictive control

- High efficiency (smooth)
- Stable





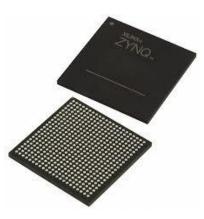


# **Technology roadmap**

# 2019 1 Starting to provide DBT as a **IP** for every devise which has **Trust Zone** (Arm's architecture)



# 2020 Starting to provide DBT as a **IP(RTL) for every FPGA**



// DCOM determines the sky texture to be used depending on the current episode, and the game version skytexture = R\_TextureNumForName ("SKY3"); skytexture = R\_TextureNumForName ("SKY1"); If (playeringamelii) G PlayerFinishLevel (i); // take away cards and stull; // force a wipe if (playeringemeti) && playerstit, playerstate == PST\_DEAD) playerstil, playerstate = PST\_REBORN; displayplayer = consoleplayer; memset (gamekeydown, O, sizeof(gamekeydown)) memset (mousebuttons, 0, sizeof/mousebuttons //#endi

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 Sorrell Instruction and Instruction
 Sorrell Instruction

auant mercane -- GBSAV

skil\_L ski Bandom 0 SARE UN1 ; i<=S\_SARG\_PAIN2 ; i++) paused = false; if ( gamemode == commercial) skytexture = R. TextureNumForName ("SKY1")

```
// do things to change the game state
                                                         while (gameaction != ga_nothing)
                                                                switch (gameaction
                                                                 case ga_loadlevel
                                                                 G_DoLoadLevel ()
                                                                 break;
                                                               -case ga_newgame
                                                                 G_DoNewGame ()
                                                                 G_DoLoadGame
                                                                 case ga_playdemo
                                                                 G_DoPlayDemo ()
                                                   SGUNFLASH1 G_DoCompleted 0
                                                                case ga_victory:
                                                                 G_DoWorldDone ()
                                                                 case ga_screenshot
                                                                 gameaction = ga_nothing;
                                                                 break;
                                                                case ga_nothing
                                                                 break;
                                                       Wigetcommands, check consistancy,
                                                       Wand build new consistancy check
                                                        buf = (gametic/ticdup)%8ACKUPTICS;
                                                        for (i=0 : i<MAXPLAYERS : i++)
                                                               if (playeringame(i))
                                            // S_CHAINFLASH1 cmd = &players[i].cmd;
                                                                 if (demoplayback)
                                                                 if (demorecording)
                                             // S_MISSILEFLASH# check for turbo cheats
70.4.(A, Light2).S. MISSLEFASHA.D.D., 7/ S. MISSLEFLSHIP on the transformatine as "TURBOTHRESHOLD
71.4.(A, Light2).S. MISSLEFASHA.D.D., 7/ S. MISSLEFLASH4 & Stransteis311 & Stafformatics>51831
                                                        // check for special buttons
                                                        for (i=0 ; i<MAXPLAYERS ; i++)
                                                               if (playeringame[i])
```

G\_ReadDemoTiccmd (cmd)

G\_WriteDemoTiccmd (cmd):

static char turbomessage[80] extern char \*player\_names14

if (players(il.mo)

case BTS\_PAUSE: paused A= 1;

if (paused)

break:

memopy (and, Snetcmdslillbufl, sizeof(ticomd\_t)); && !(gametic&31) && ((gametic>>5)&3) == i ) sprintf (turbomessage, "%s is turbo!",player\_nameslil); playerstconsoleplayer1.message = turbomessage;

if (netgame && Inetdemo && I(gametic%ticdup) ) && consistancy/illbufl != cmd->consistancy) LError l'consistency failure (% should be %), emd->consistancy, consistancy(illbufl); consistancylillbufl = playerslil.mo->x; consistancyfillbufl = mdindex; if (playerslil.cmd.buttons & BT\_SPECIAL) switch (players1i).cmd.buttons & BT\_SPECIALMASK) S\_PauseSound 0; S\_ResumeSound ();