Dipartimento di Ingegneria e Architettura

UNIVERSITÀ DEGLI STUDI DI TRIESTE

Introduzione a LabVIEW

Corso: MISURE MECCANICHE, TERMICHE E COLLAUDI [113MI]

Prof. Lucia Parussini
Prof. Rodolfo Taccani
Prof. Ronelly De Souza

A.A. 2026/2027

Obiettivi della lezione:

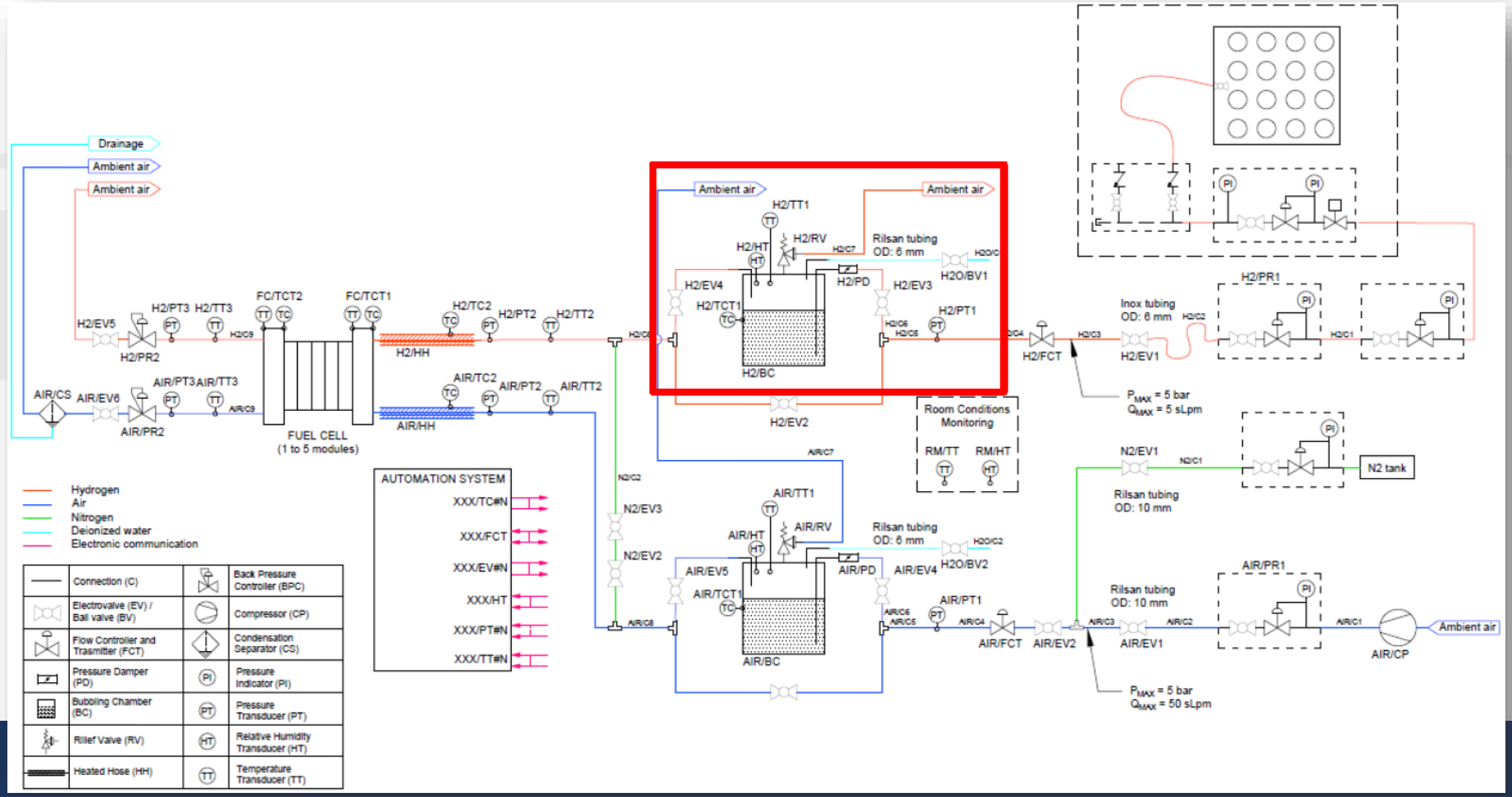
- Capire cos'è LabVIEW e in quali contesti viene usato
- Definire la programmazione a flusso di dati
- Introdurre il concetto e l'architettura di un «Virtual Instrument»
- Introdurre i «Palettes» (controlli e funzioni)
- Fornire delle istruzioni per installare LabVIEW

LabVIEW: definizioni e applicazioni

Collegamento con il corso

Strumenti e sensori che generano dati in **tempo reale**

LabVIEW
automatizzare la misura, **acquisire** dati dai sensori, **elaborarli** e **visualizzarli**



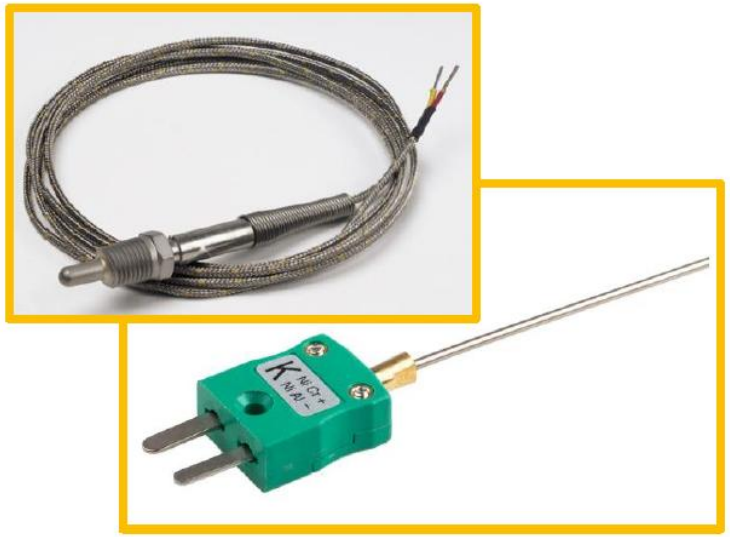
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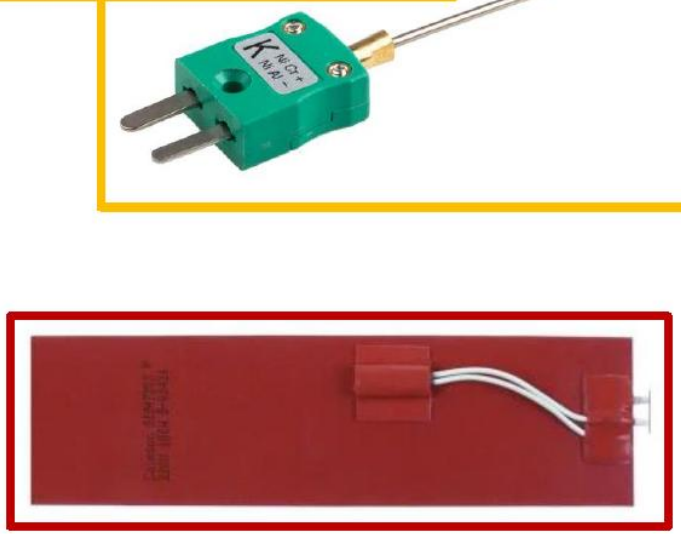
Collegamento con il corso

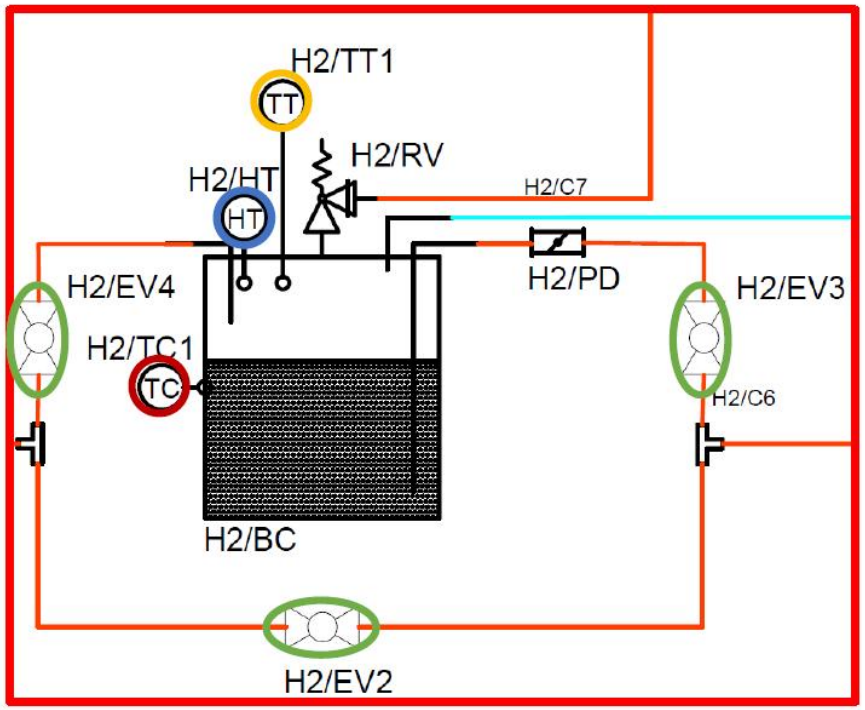
Strumenti e sensori che generano dati in **tempo reale**

→

LabVIEW
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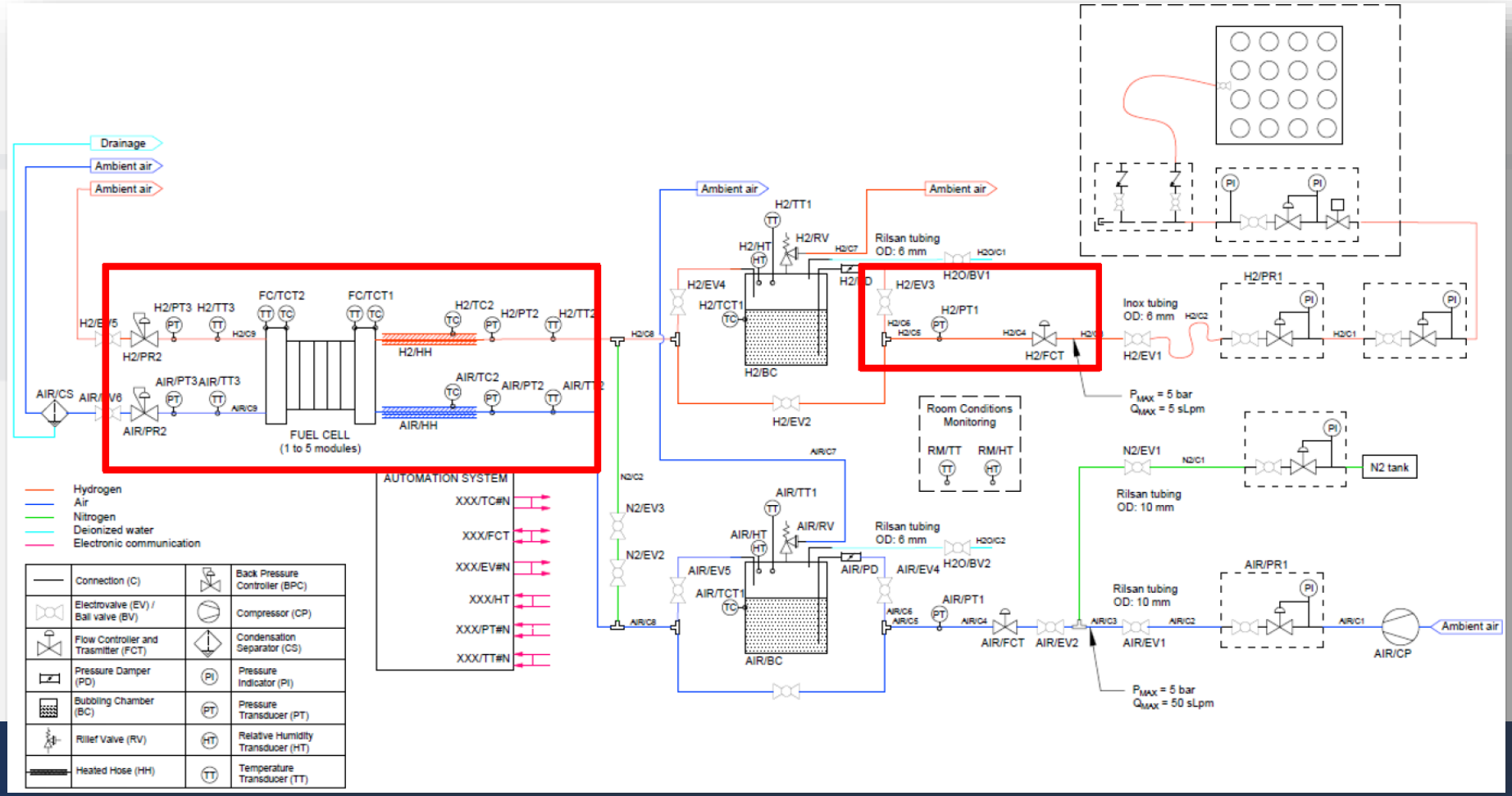


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Collegamento con il corso

Strumenti e sensori che generano dati in **tempo reale**

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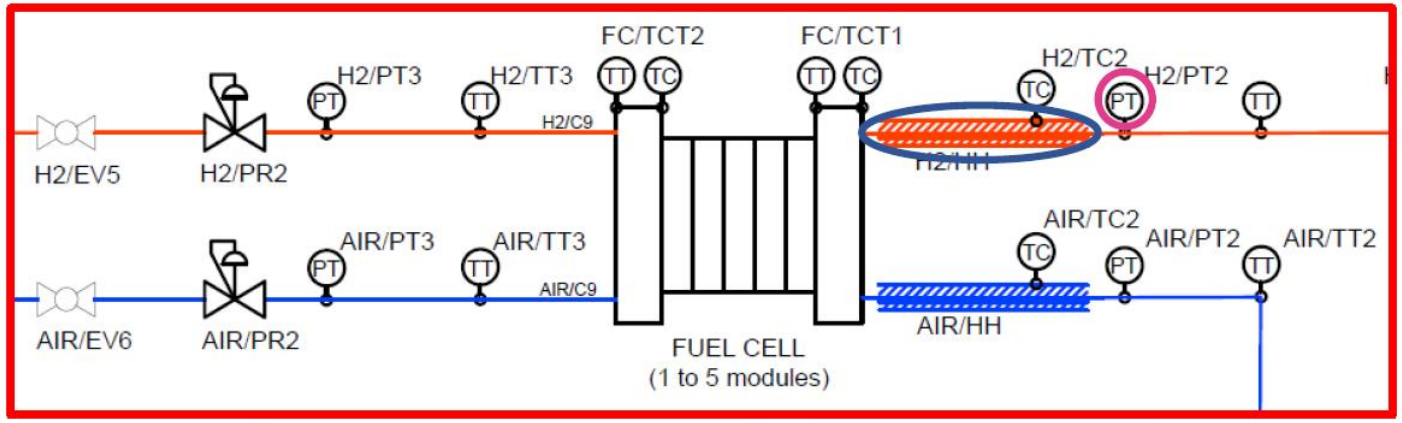


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Collegamento con il corso

Strumenti e sensori che generano dati in **tempo reale**

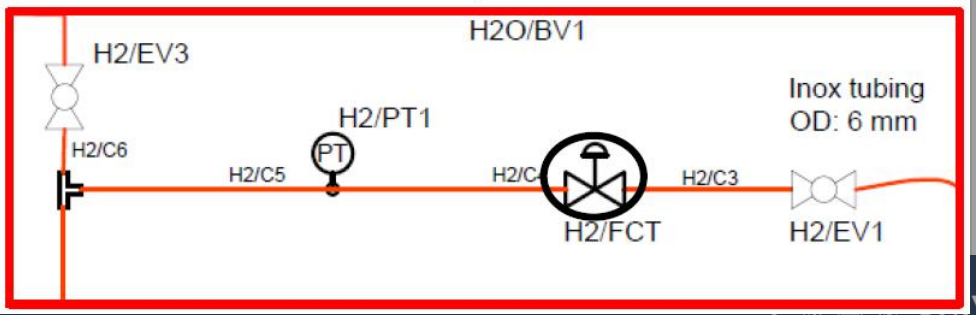
LabVIEW
automatizzare la misura, **acquisire** dati dai sensori, **elaborarli** e **visualizzarli**











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National Instruments

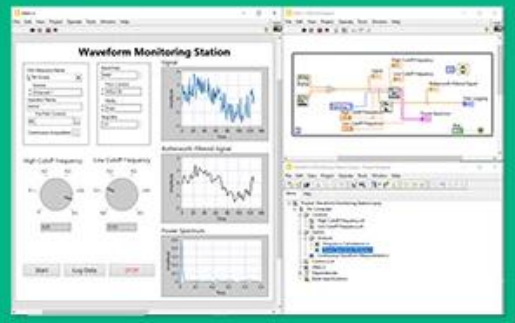
PXI

Meet demanding test objectives with the widest portfolio of industry-leading modular instruments and configurable software interfaces.



LabVIEW+ Suite

Get the job done faster with engineering-specific software for measurement, analysis, and test.



CompactDAQ Modules

Achieve precise measurement quality with built-in signal conditioning for sensors, voltage, current, and digital I/O.



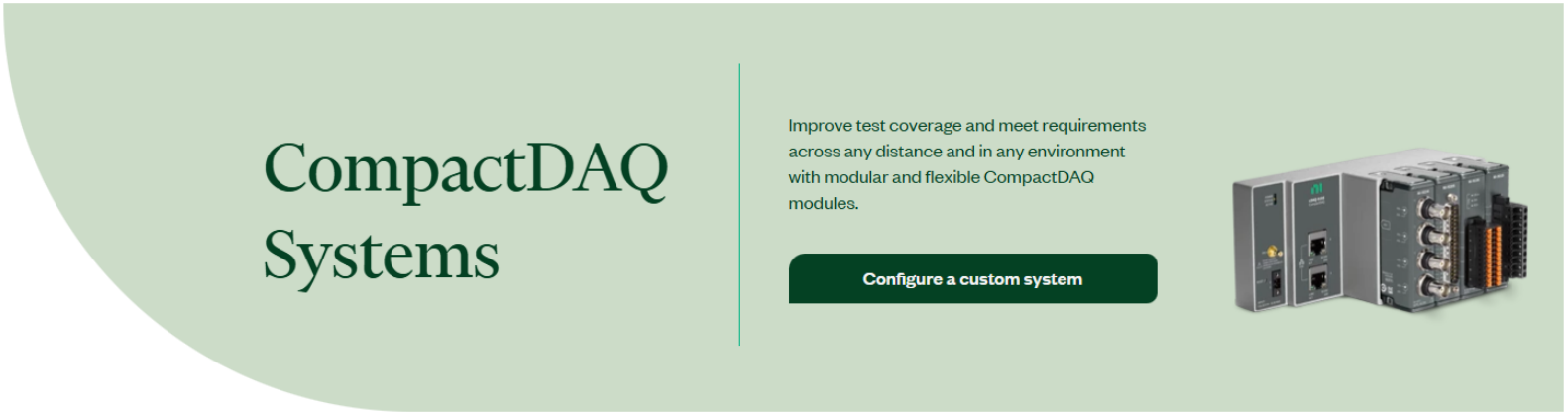
National Instruments



- Data Acquisition (DAQ) è il processo di **misurazione di un fenomeno** elettrico o fisico, come tensione, corrente, temperatura, pressione o suono.
- Un sistema DAQ è composto da **sensori, hardware di misurazione DAQ e un computer** con software programmabile come LabVIEW.

National Instruments





Principali caratteristiche:

- Precisione
- Flessibile
- Scalabile
- Programmabile



National Instruments





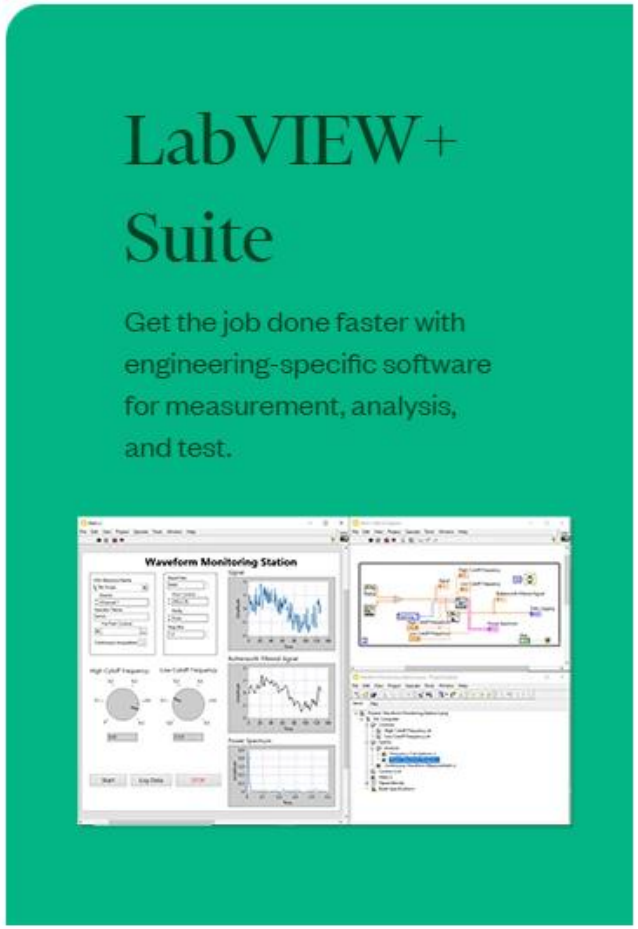
Condizionamento del segnale

- Moduli diversi per sensori diversi.
- «Traduttori» del segnale del sensore al linguaggio digitale.

Esempi:

- Termocoppia: genera un **segnale elettrico** nell'ordine dei **microvolt**. Inoltre, serve un riferimento (**giunto freddo**).
- Pressione: cambiano la loro **resistenza elettrica** quando vengono schiacciati o tesi. Variazione rilevata tramite un **circuito a ponte**.

National Instruments



LABoratory Virtual Instrument Engineering Workbench

- Sviluppato da National Instruments, oggi “NI by Emerson”.
- Programmazione grafica basato su blocchi e connessioni (non testuale).

Concetto di “Virtual Instrument”

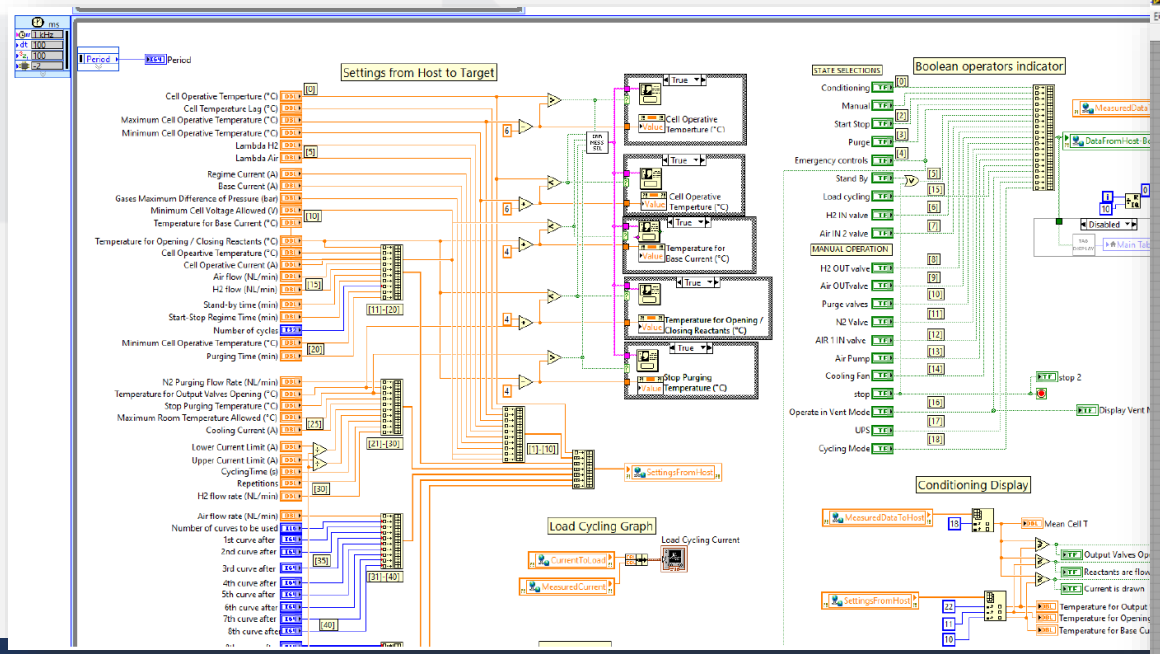
Laboratorio reale →



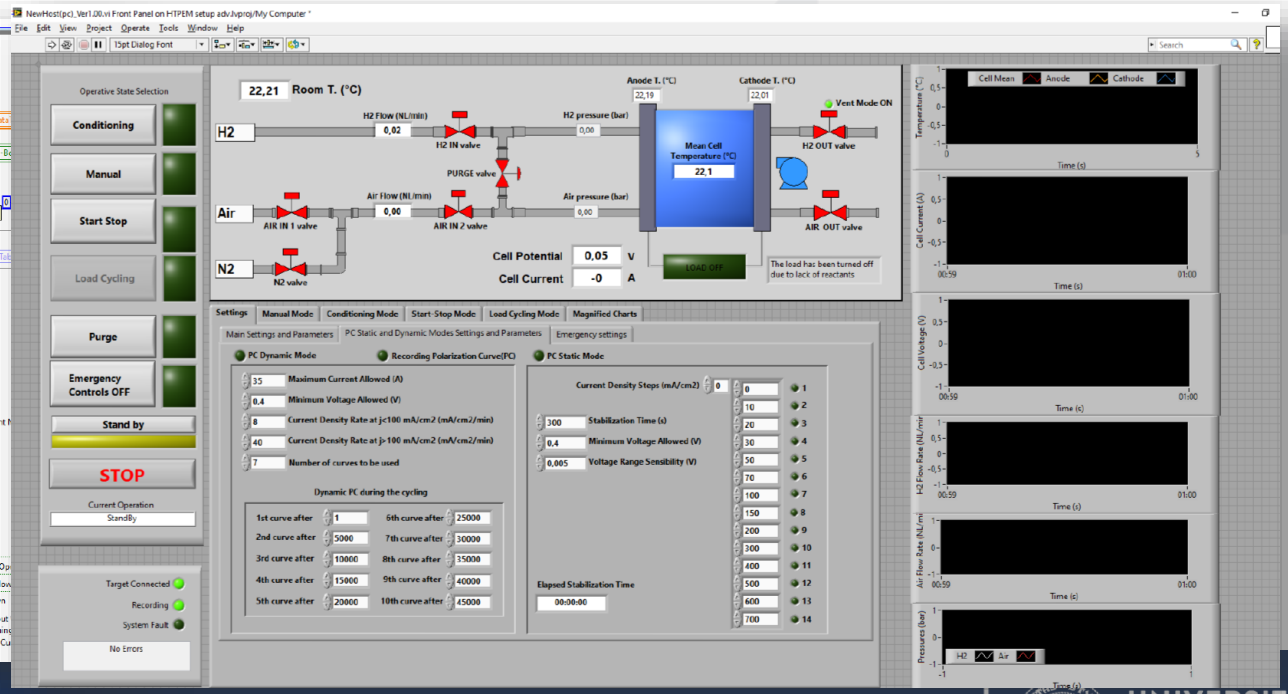


LabVIEW

Block Diagram



Front Panel



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Ambiti di applicazione

- **Ricerca e laboratorio:** acquisizione e analisi di segnali (termocoppie, flussi, pressioni, ecc.)
- **Industria:** banchi prova motori, test di componenti meccanici o elettronici.
- **Automazione:** controllo di processo (pompe, valvole, PLC).
- **Didattica:** esperimenti di misura controllati da PC.



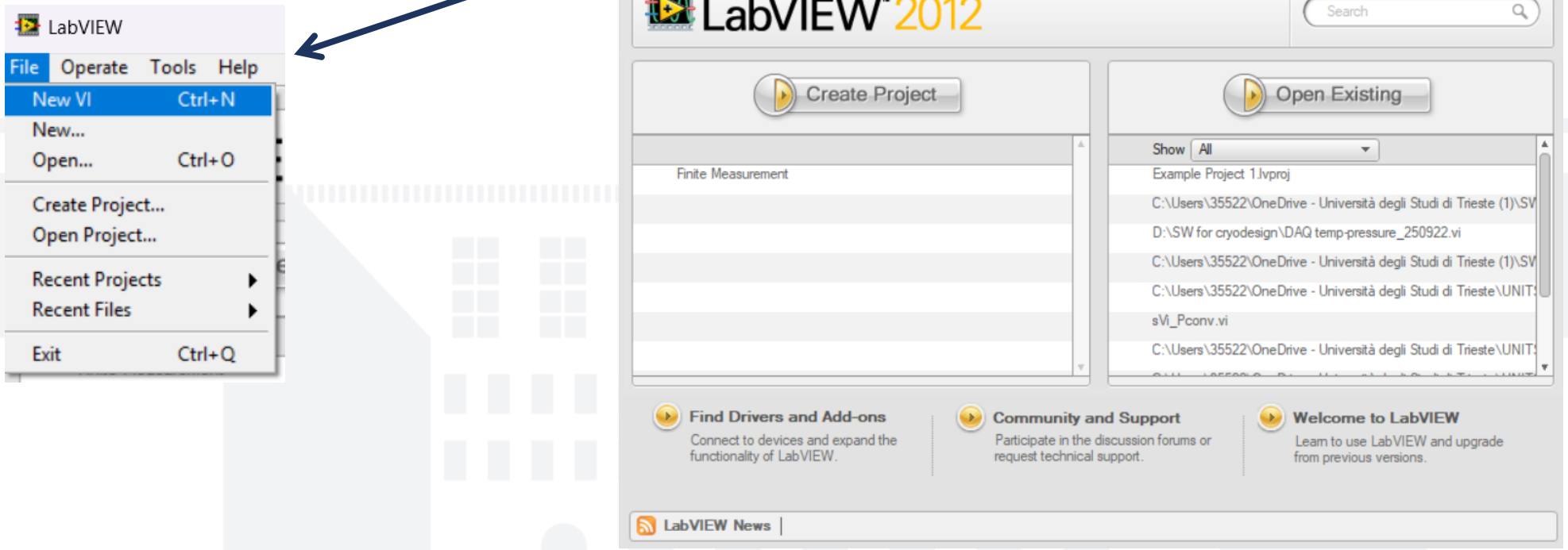


Vantaggi principali

- Programmazione grafica a **flusso di dati**
- **Integrazione diretta** con hardware di misura
- Ambiente unificato per **acquisizione, analisi e visualizzazione**
- Ampia disponibilità di **strumenti e moduli**

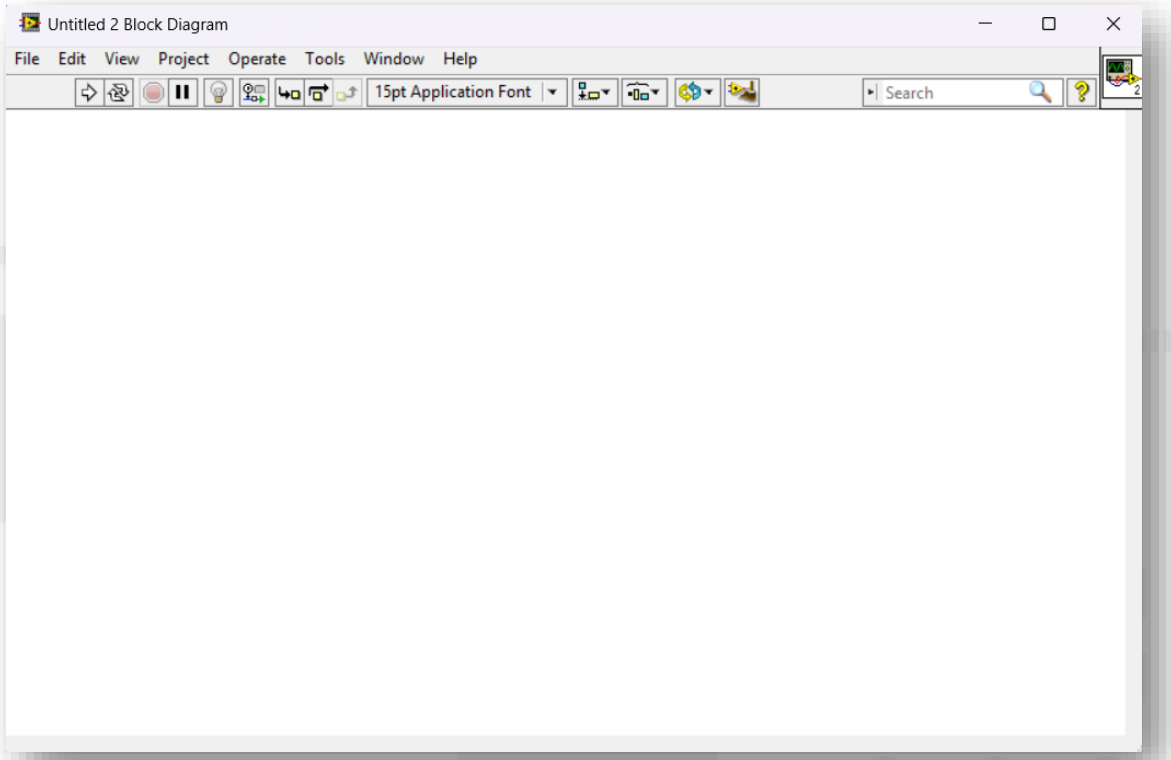
LabVIEW **non è sempre la scelta più adatta** per ogni applicazione: per elaborazioni numeriche o simulazioni complesse, **linguaggi testuali come Python o MATLAB** possono offrire maggiore flessibilità.
Tuttavia, LabVIEW eccelle quando **acquisizione, controllo e interfaccia grafica** devono convivere in modo integrato.

Interfaccia utente di LabVIEW

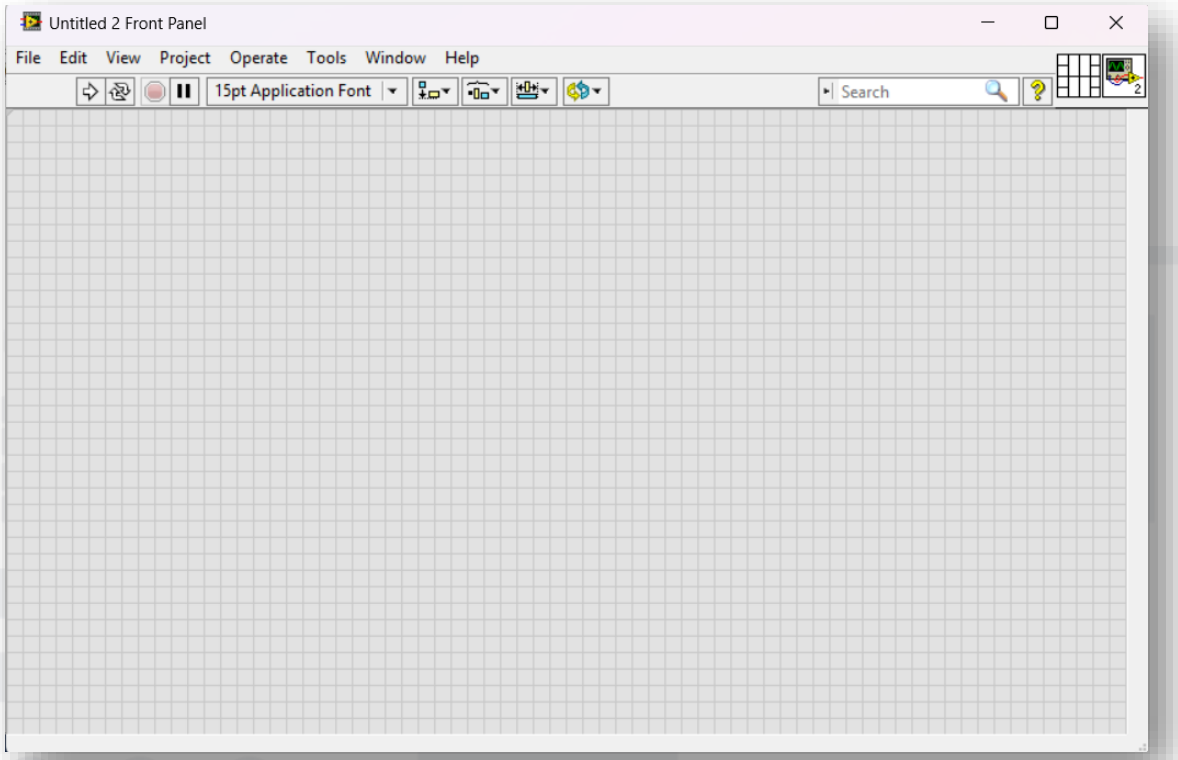


Interfaccia utente di LabVIEW

Block Diagram

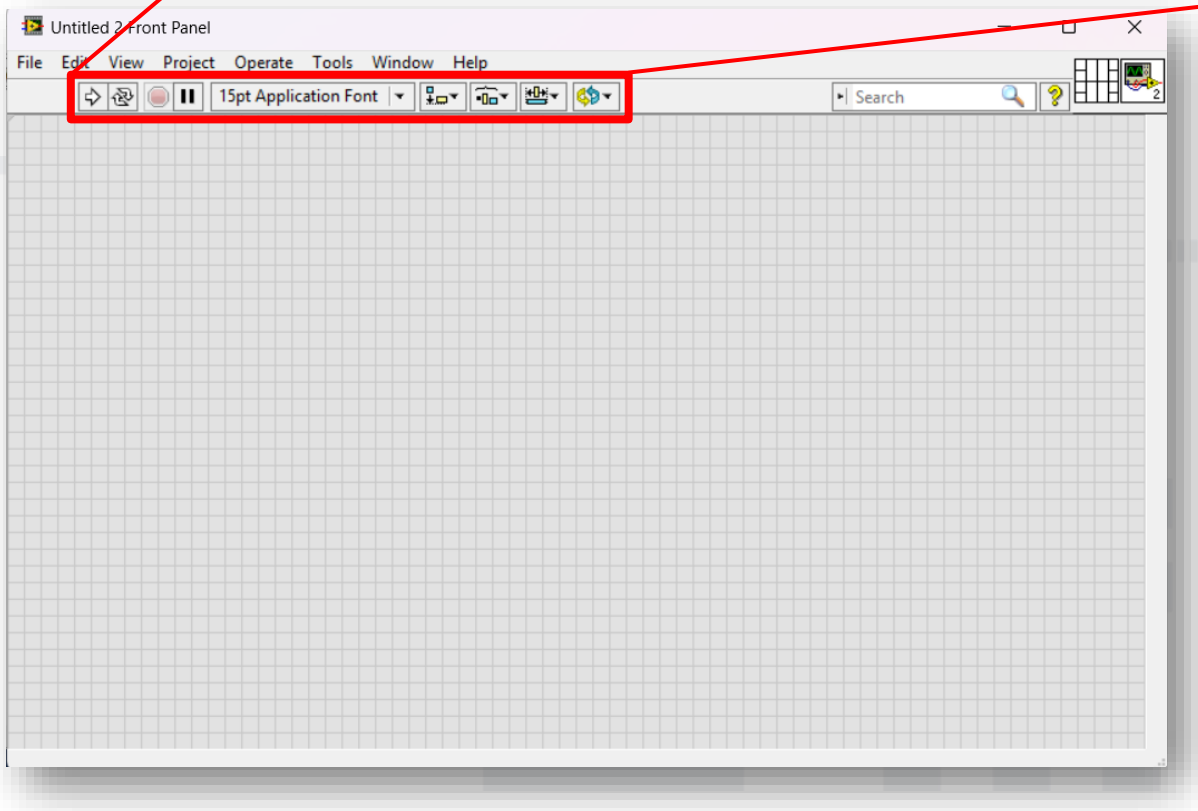


Front Panel



Interfaccia utente di LabVIEW

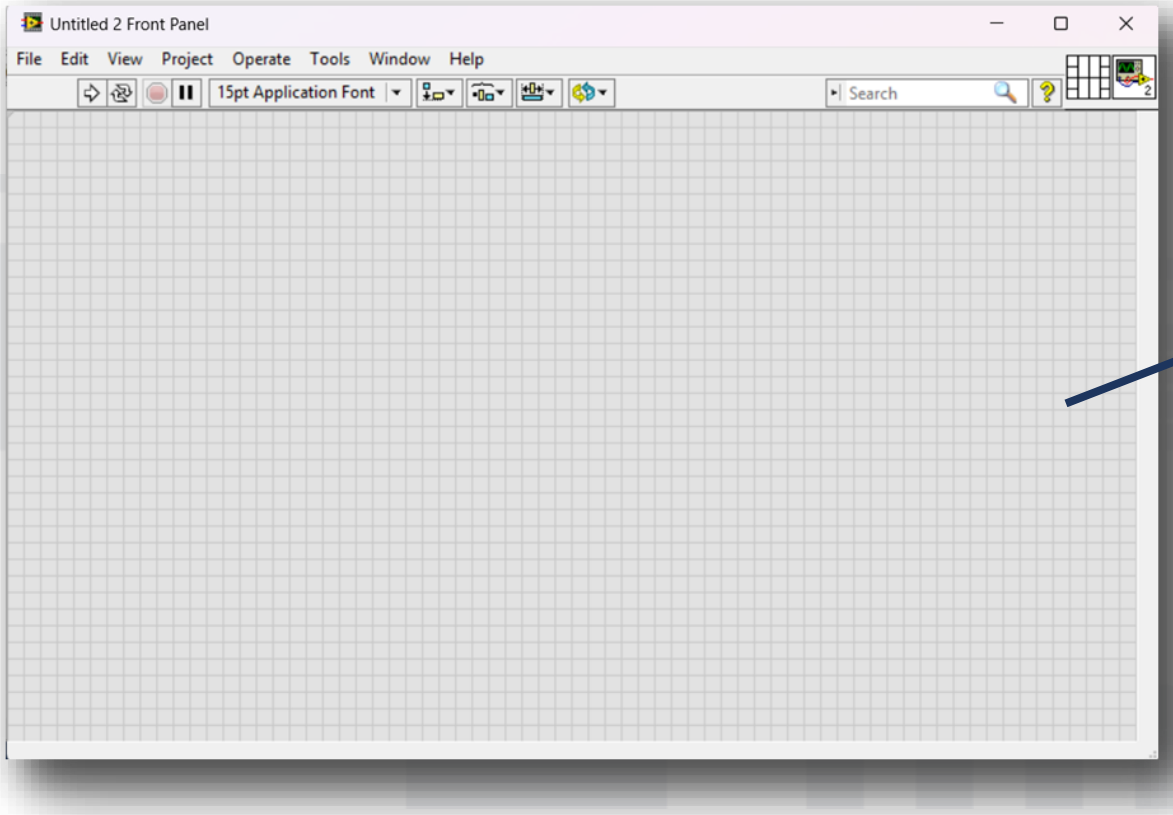




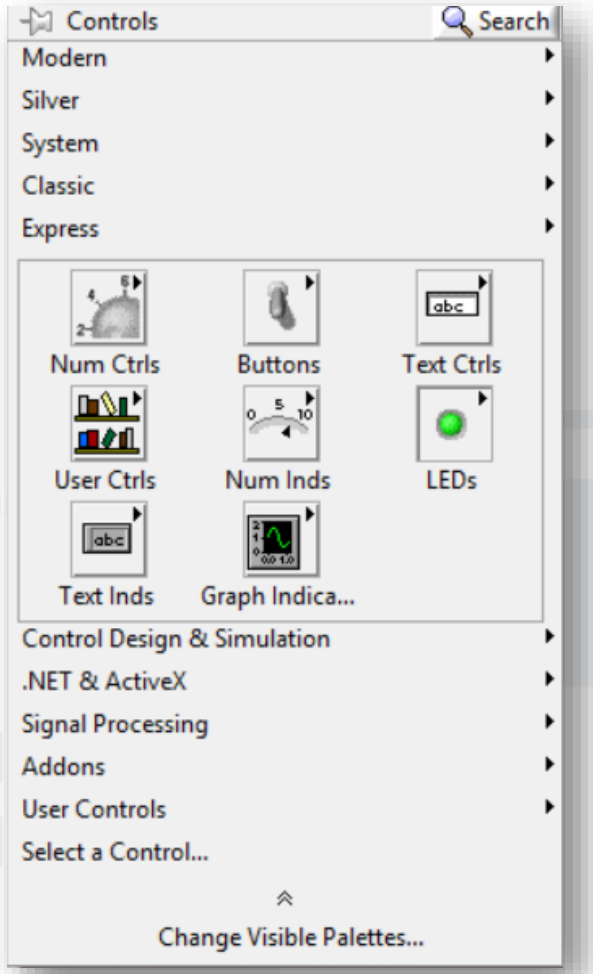
Front Panel

Interfaccia utente di LabVIEW

Front Panel



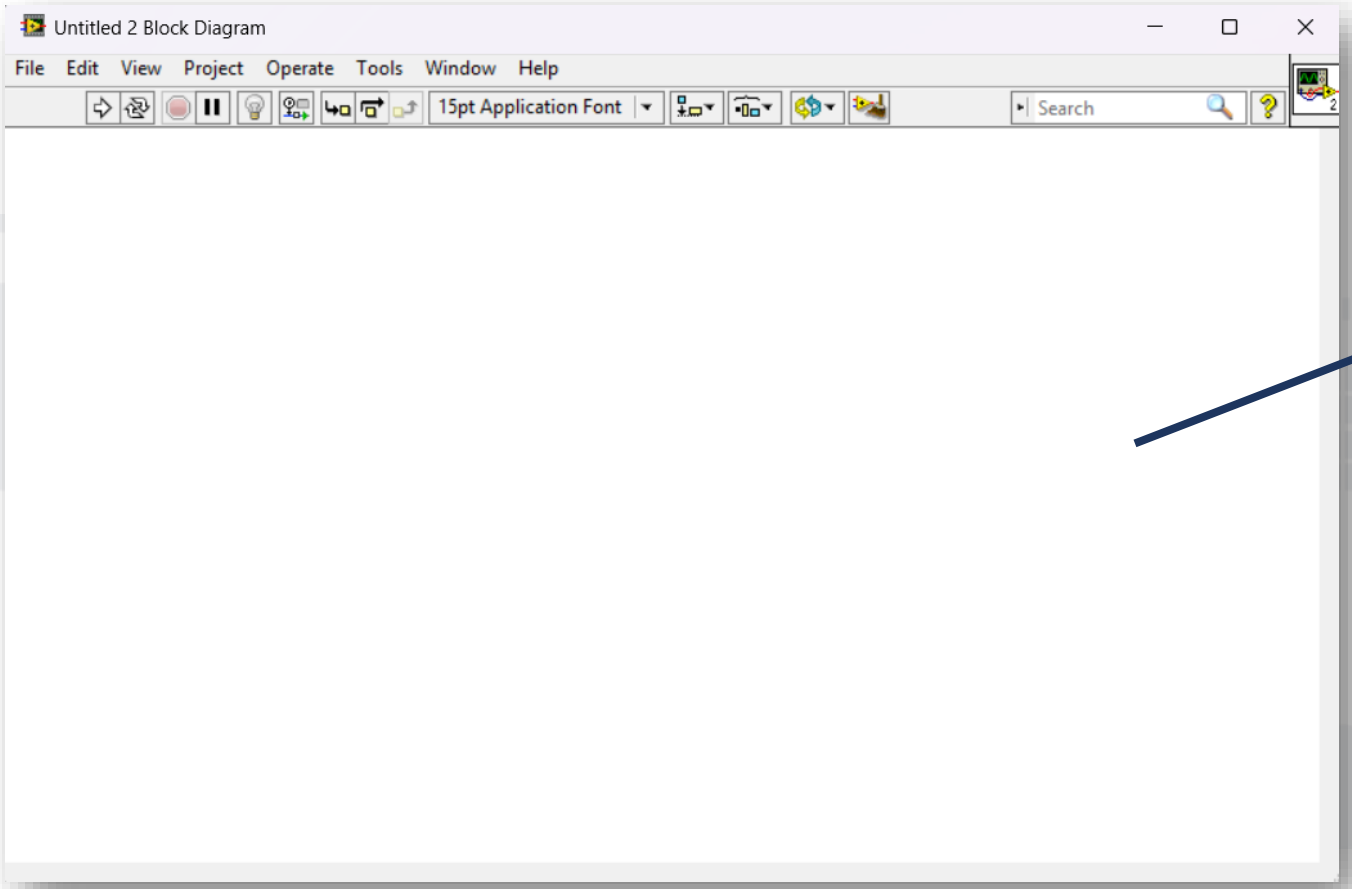
Palette



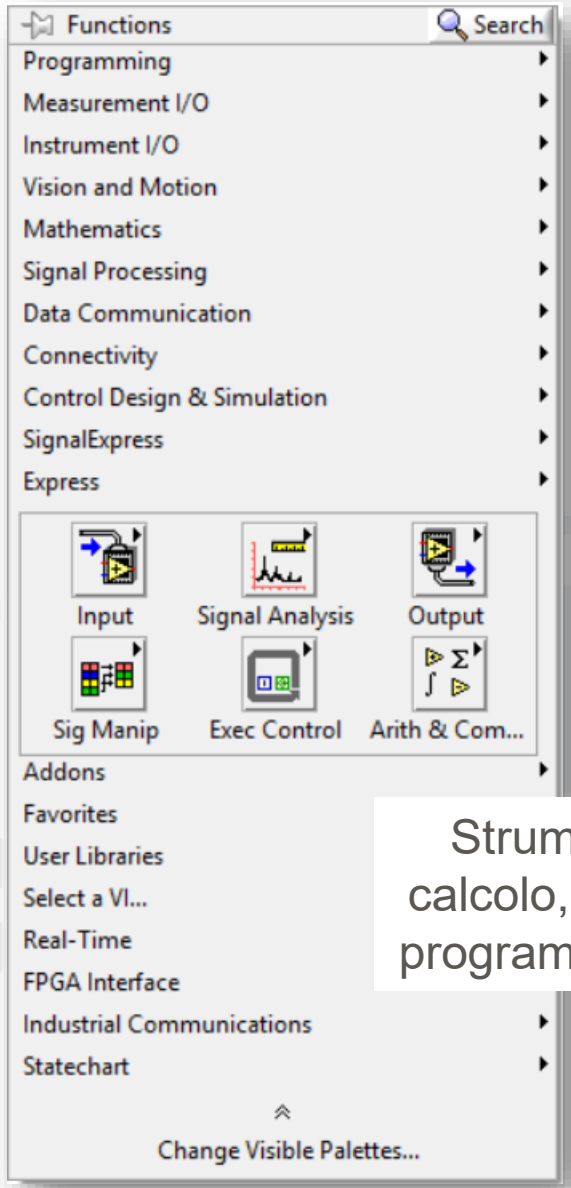
Oggetti visivi e di interfaccia.

Interfaccia utente di LabVIEW

Block Diagram



Palette



Strumenti di calcolo, logica e programmazione

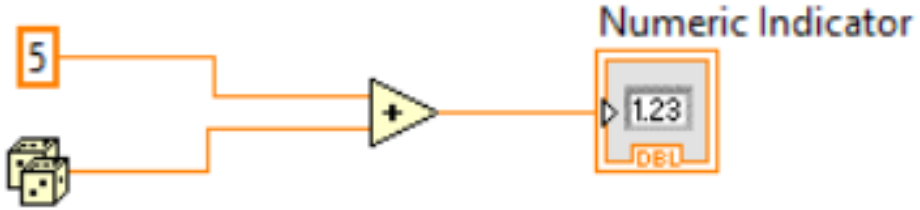
Programmazione a flusso di dati

Confronto tra linguaggio sequenziale e dataflow

	LabVIEW	Linguaggi testuali (C, Python)
Architettura	blocchi che rappresentano funzioni	Righe di codice
Ordine di esecuzione	determinato dalla **disponibilità dei dati** in ingresso	istruzioni eseguite **una dopo l'altra** in ordine di scrittura

Elementi base del diagramma a blocchi in LabVIEW

- **Nodo, filo, terminale**



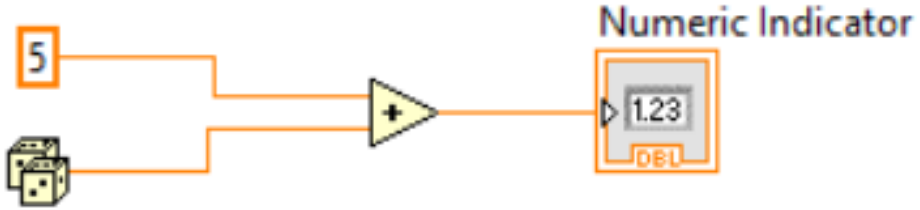
- **Nodo:** blocco funzionale che esegue un'operazione.
- **Filo:** Rappresenta il flusso di dati tra nodi.
- **Terminale:** punto di ingresso o uscita dei dati nel VI.

Confronto tra linguaggio sequenziale e dataflow

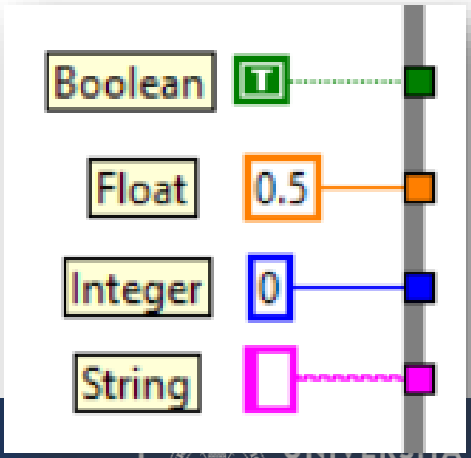
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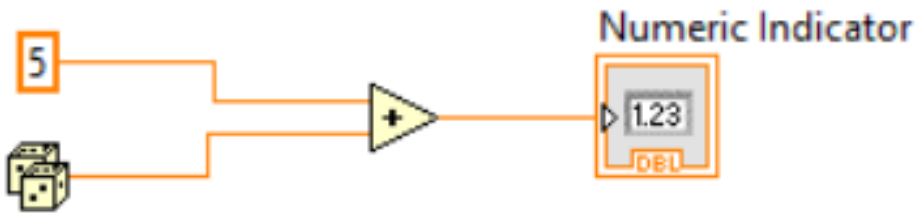


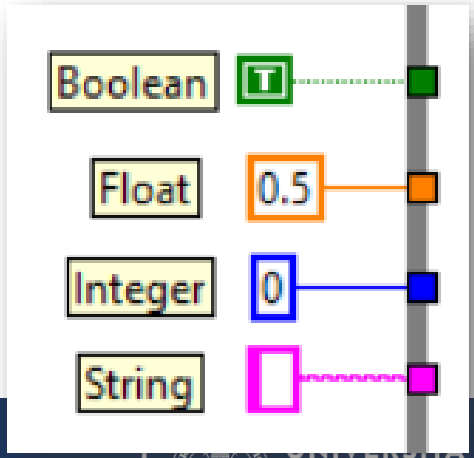
- **Filo:** Ogni filo ha un tipo di dato (colore differente per numerico, booleano, stringa, ecc.)



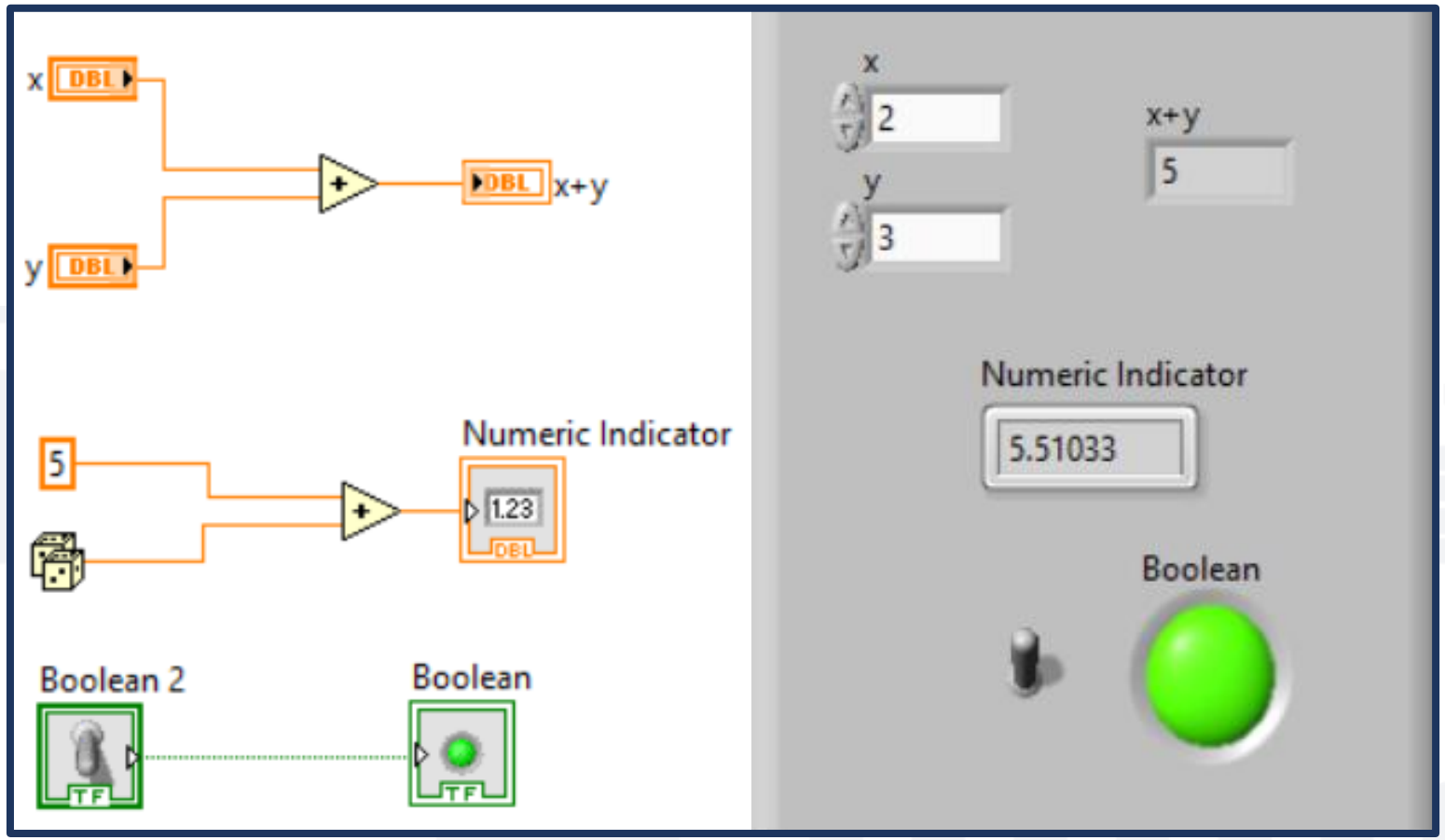
Regola di esecuzione

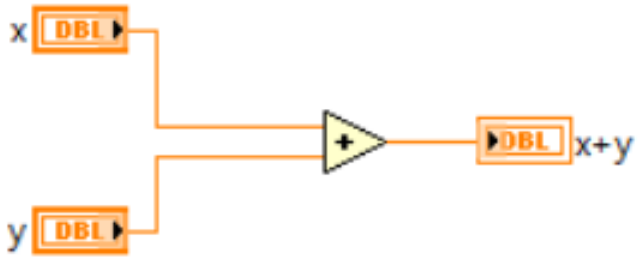
- Un **nodo si esegue** solo quando tutti i suoi ingressi hanno ricevuto **dati validi**.
- I nodi producono dati in uscita solo **dopo l'esecuzione**.
- **L'ordine fisico** dei nodi nel diagramma **non conta**.
- **Operazioni** indipendenti vengono eseguite in **parallelo**.

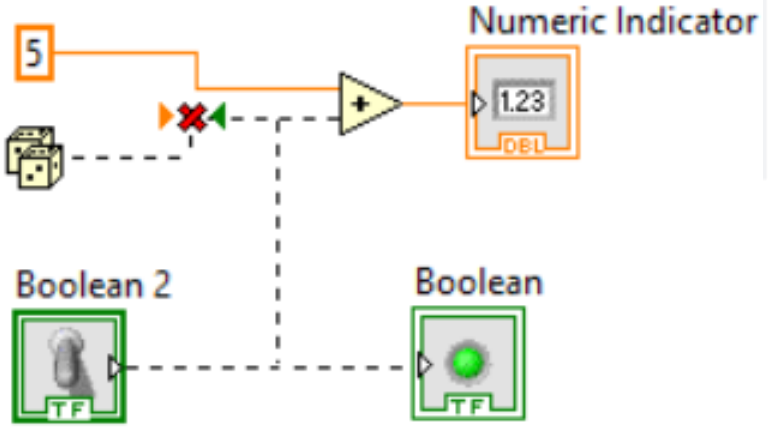




Esempi

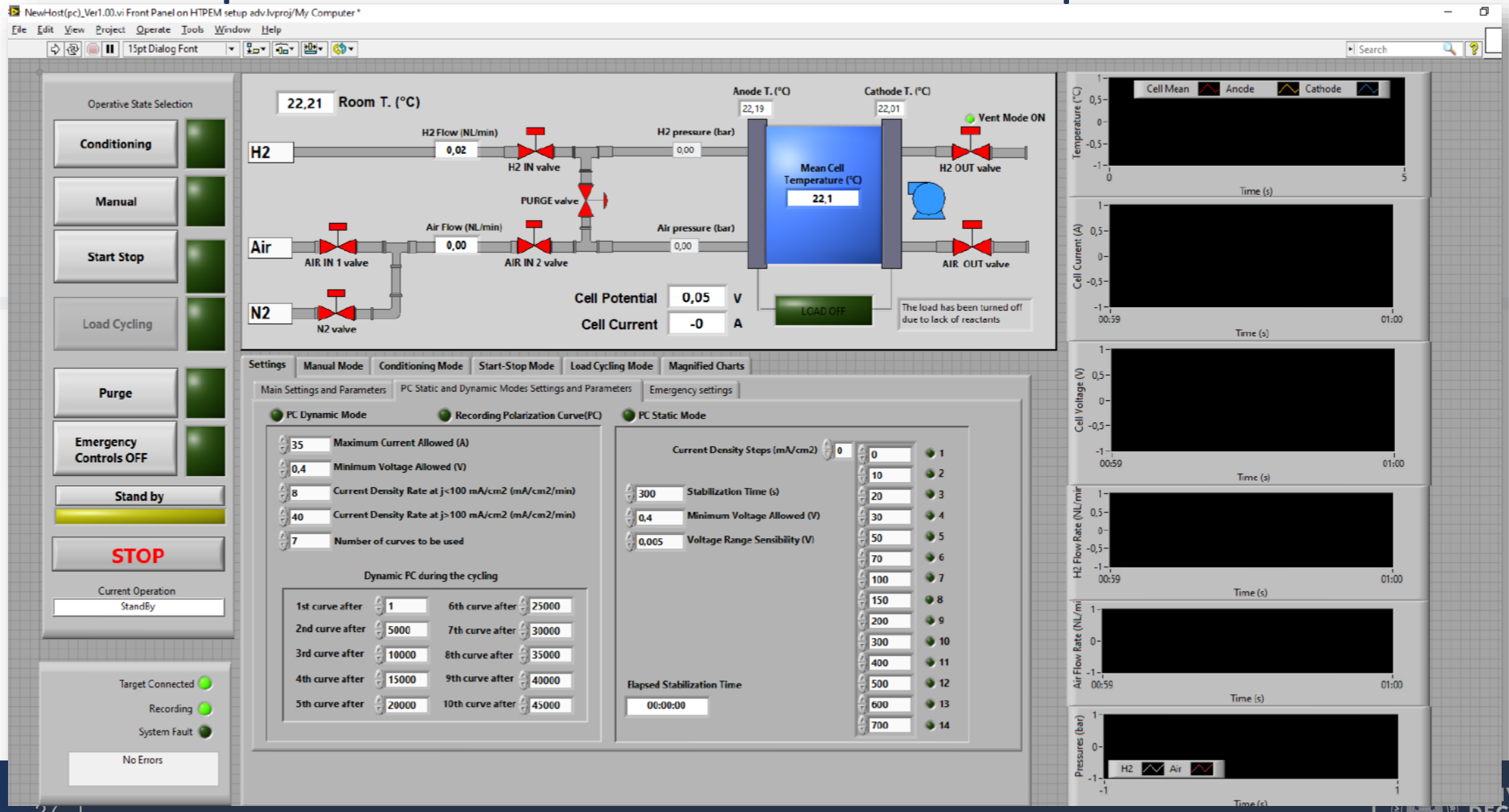

x
DBL
y
DBL
x+y
5
Numeric Indicator
1.23
Boolean 2
Boolean
TF
x
2
y
3
x+y
5
Numeric Indicator
5.51033
Boolean


x
DBL
y
DBL
x+y


5
Numeric Indicator
1.23
Boolean 2
Boolean
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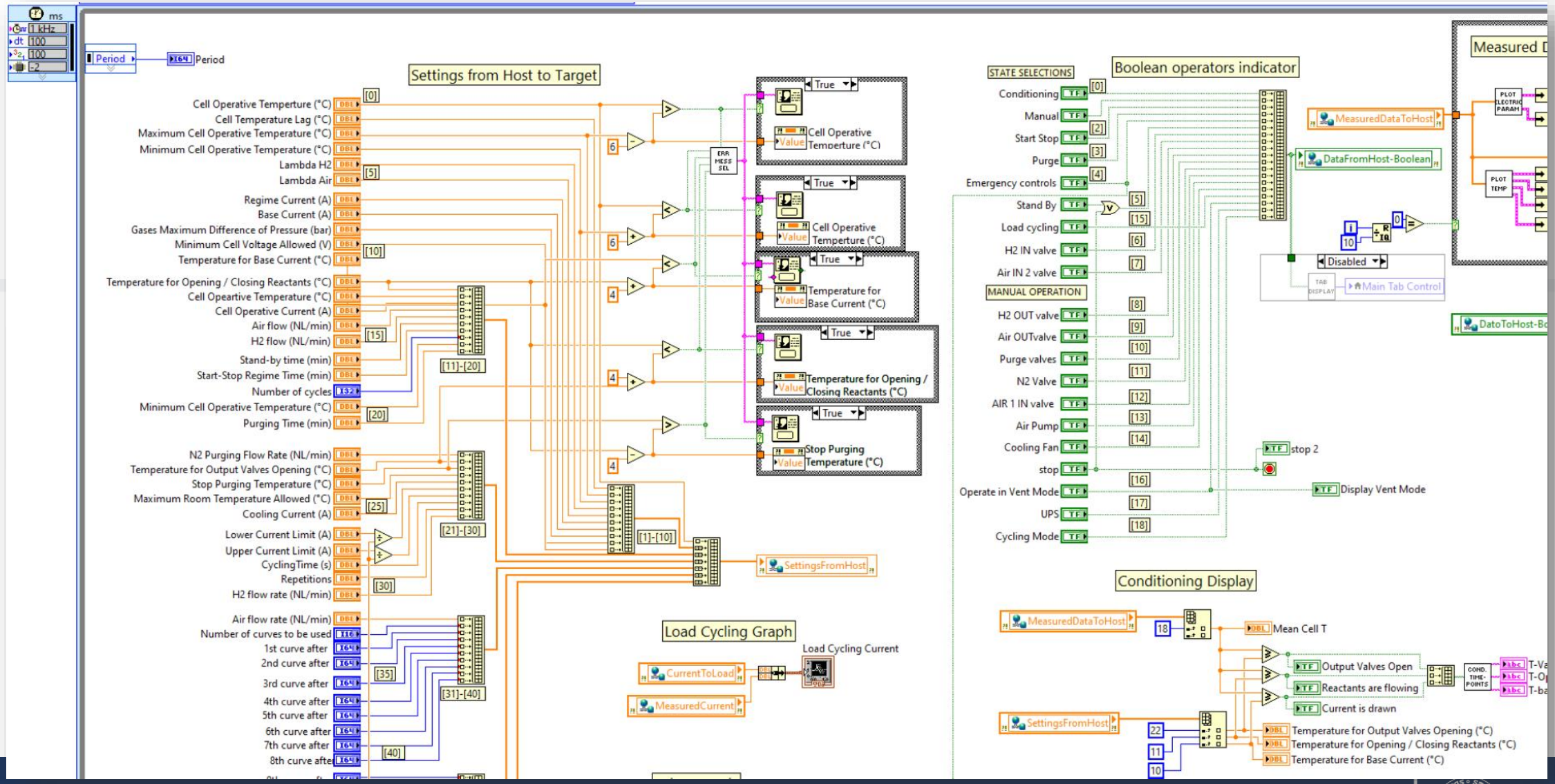
Architettura di un Virtual Instrument (VI)

VI – esempi reali nel nostro lab – Fuel cell plant

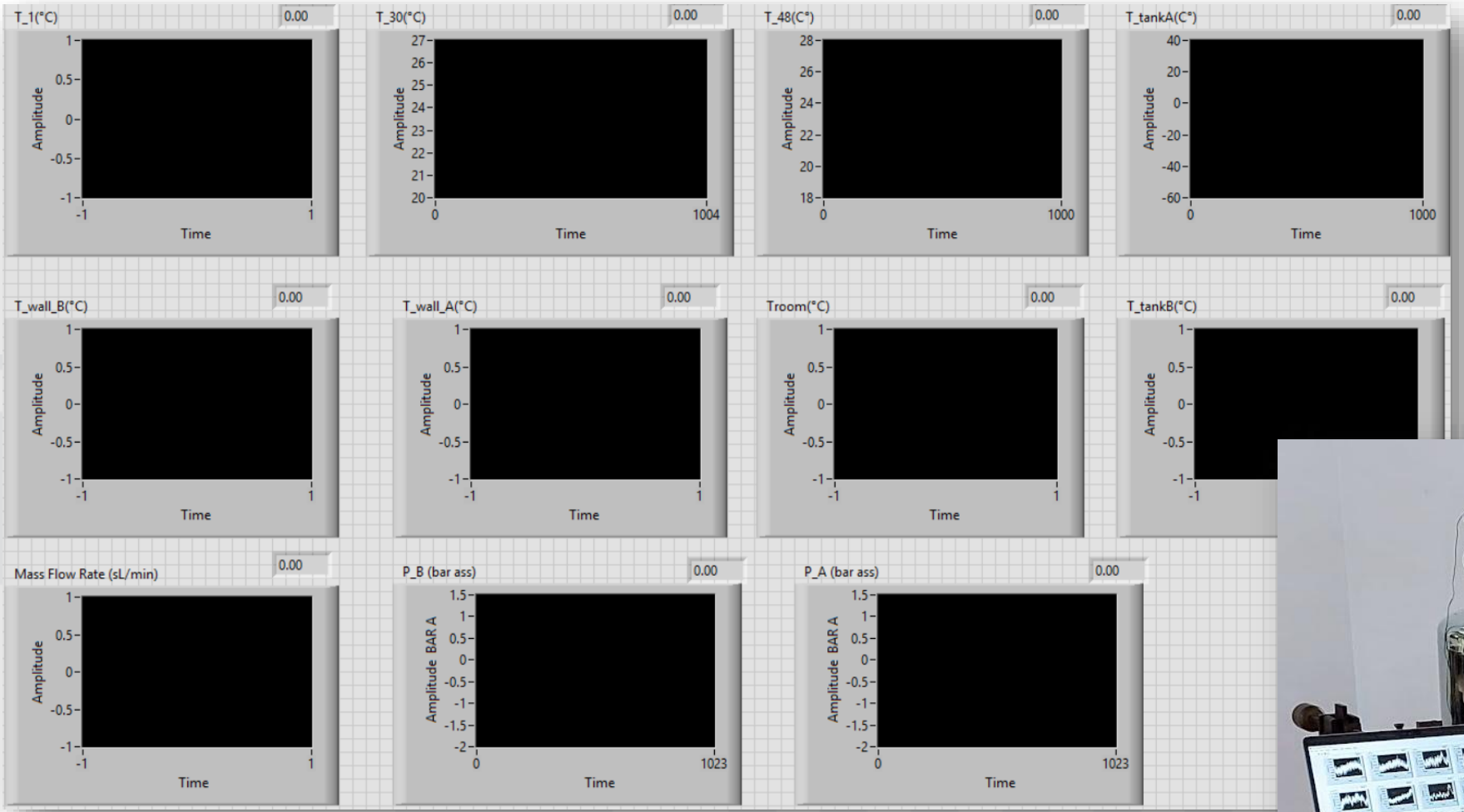


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VI – esempi reali nel nostro lab – Fuel cell plant

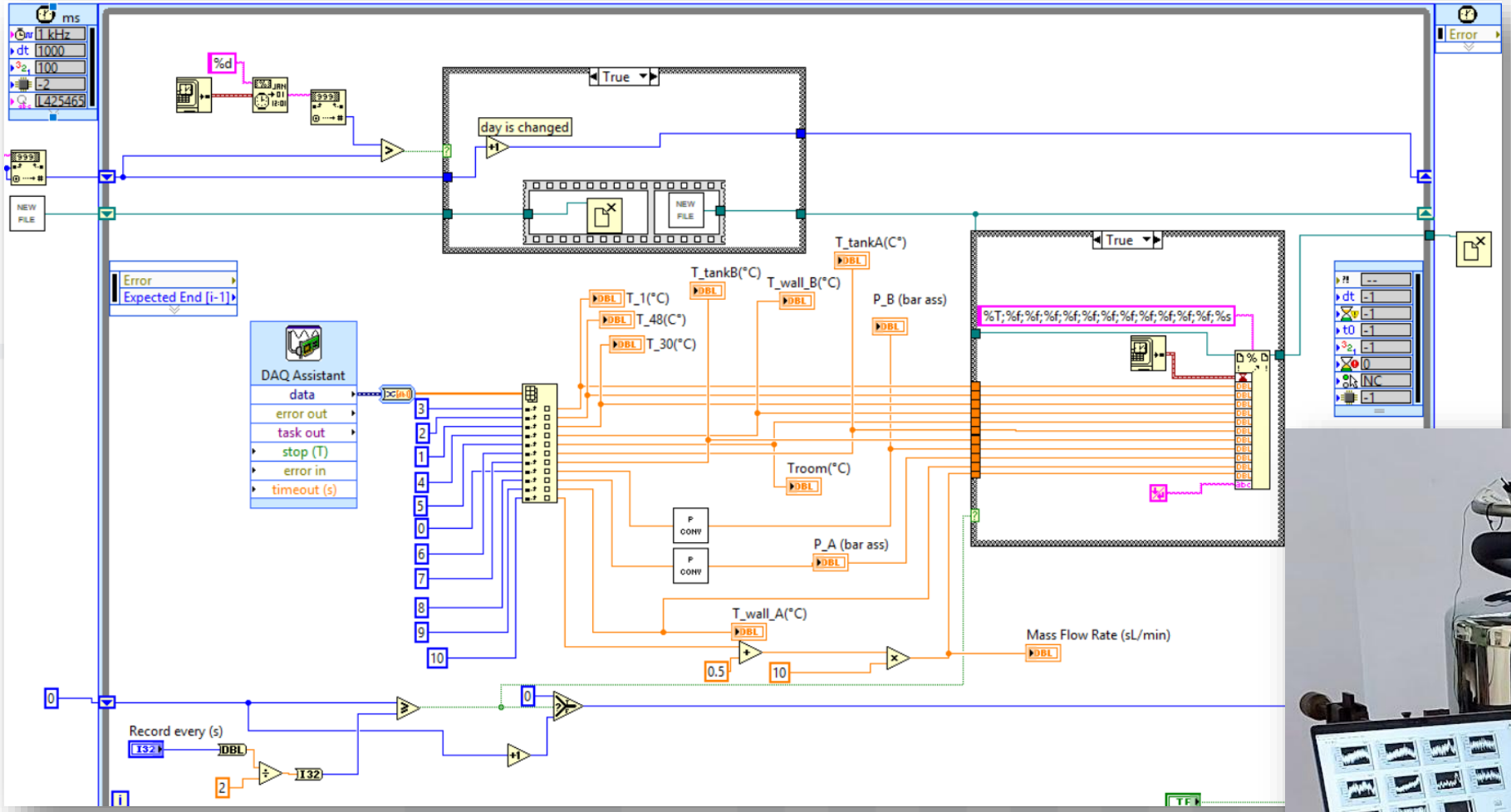


VI – esempi reali nel nostro lab – Cryogenic storage plant





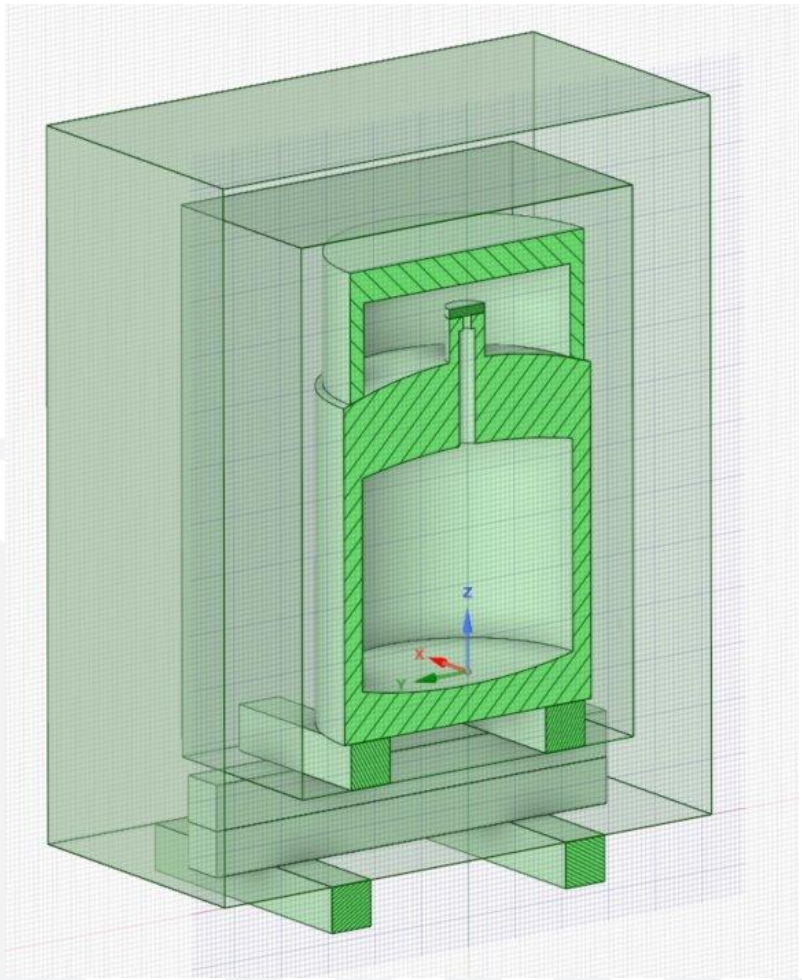
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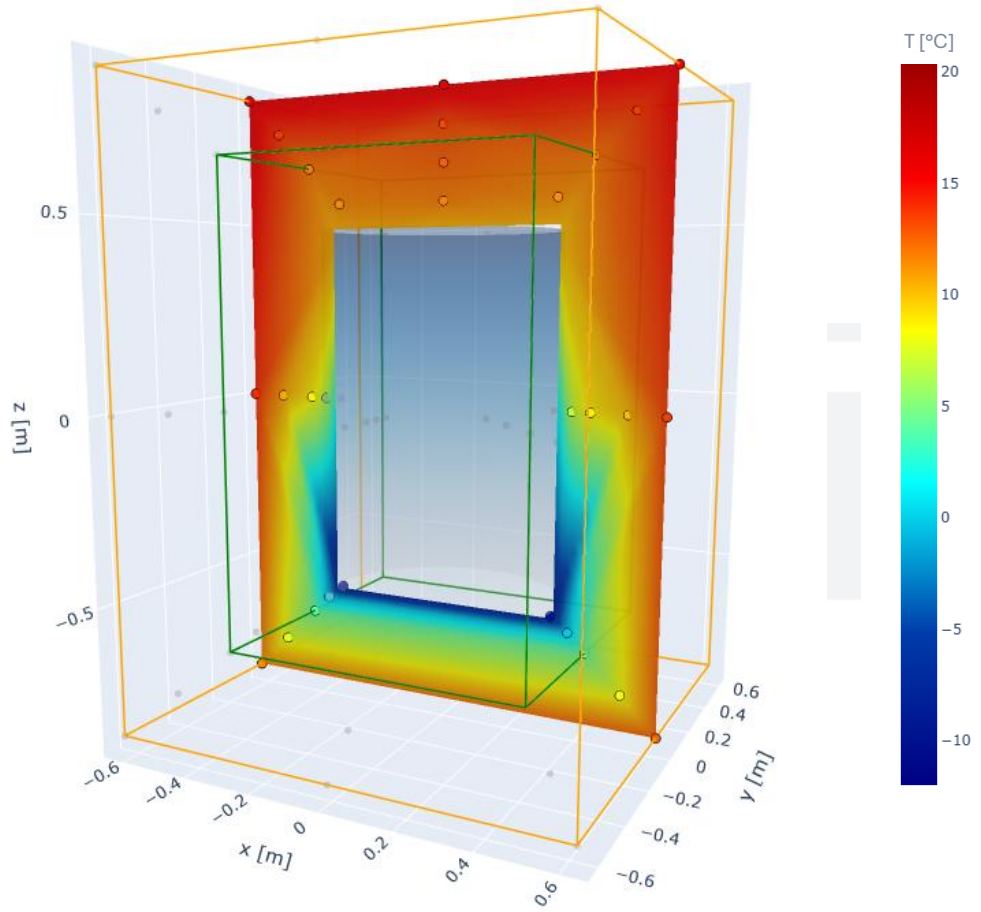




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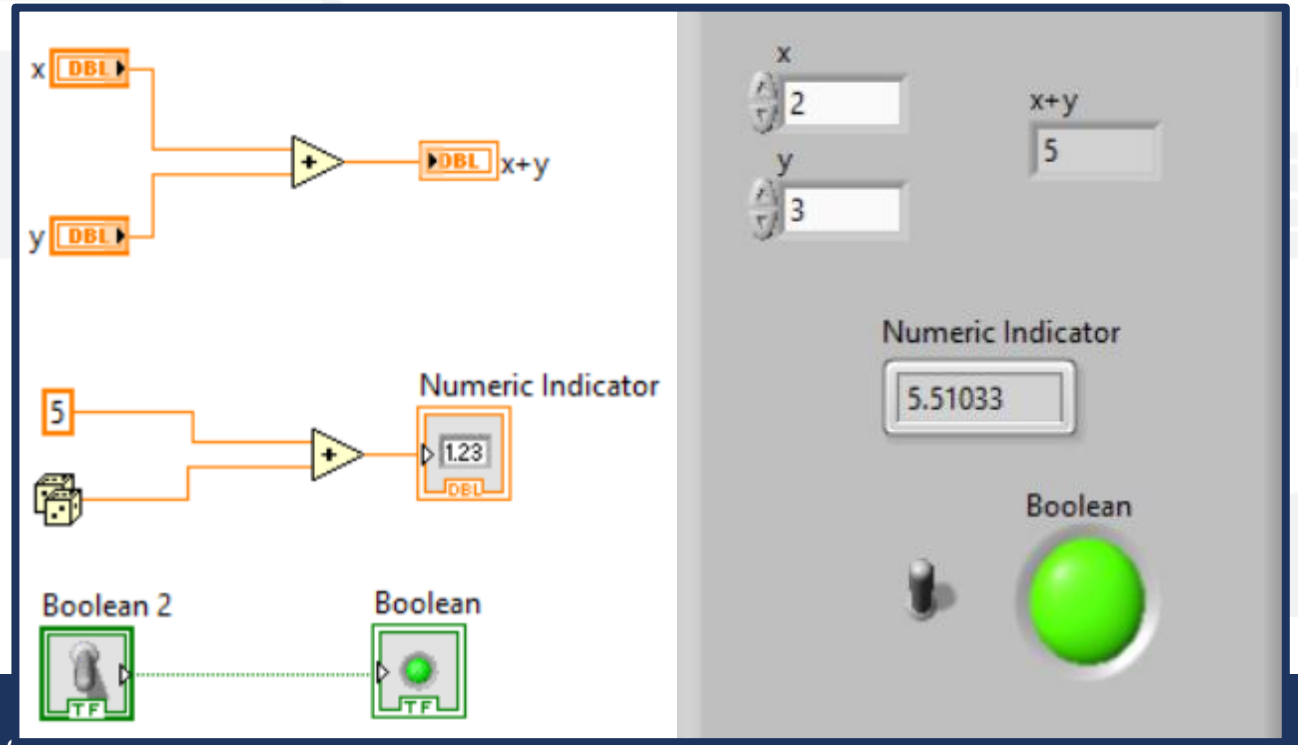






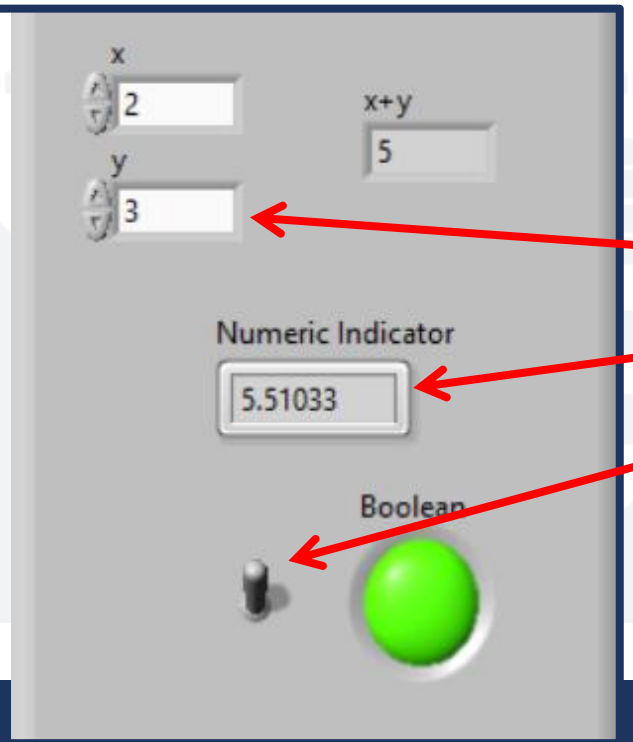
VI – definizione e ruolo in LabVIEW

- **Ogni programma** in LabVIEW è chiamato VI – **Virtual Instrument**.
- È **l'unità base di lavoro**, equivalente a un programma o funzione in altri linguaggi.
- **Ogni VI** può essere eseguito singolarmente o **richiamato** all'interno di altri VI (subVI).



Il Front Panel

- È **l'interfaccia utente** del VI: dove l'utente **inserisce dati** e **vede risultati**.
- Contiene **controlli** (input) e **indicatori** (output).
- Ogni elemento ha un corrispondente "terminale" nel Block Diagram.

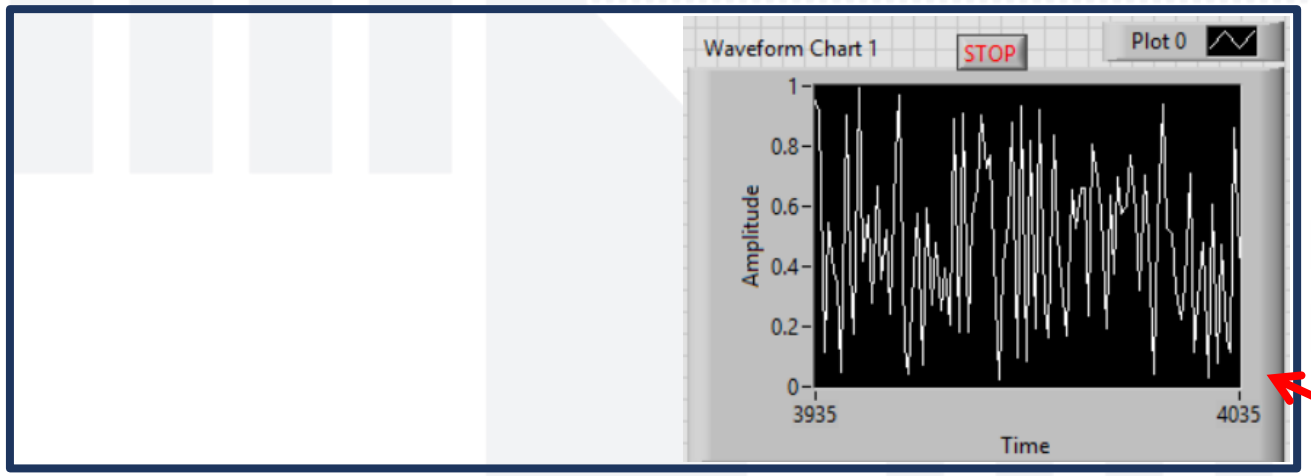


Esempi:

- Controllo numerico (input di un valore)
- Indicatore numerico (mostra un risultato)
- Controllo booleano (pulsante On/Off)
- Grafico (mostra un segnale nel tempo)

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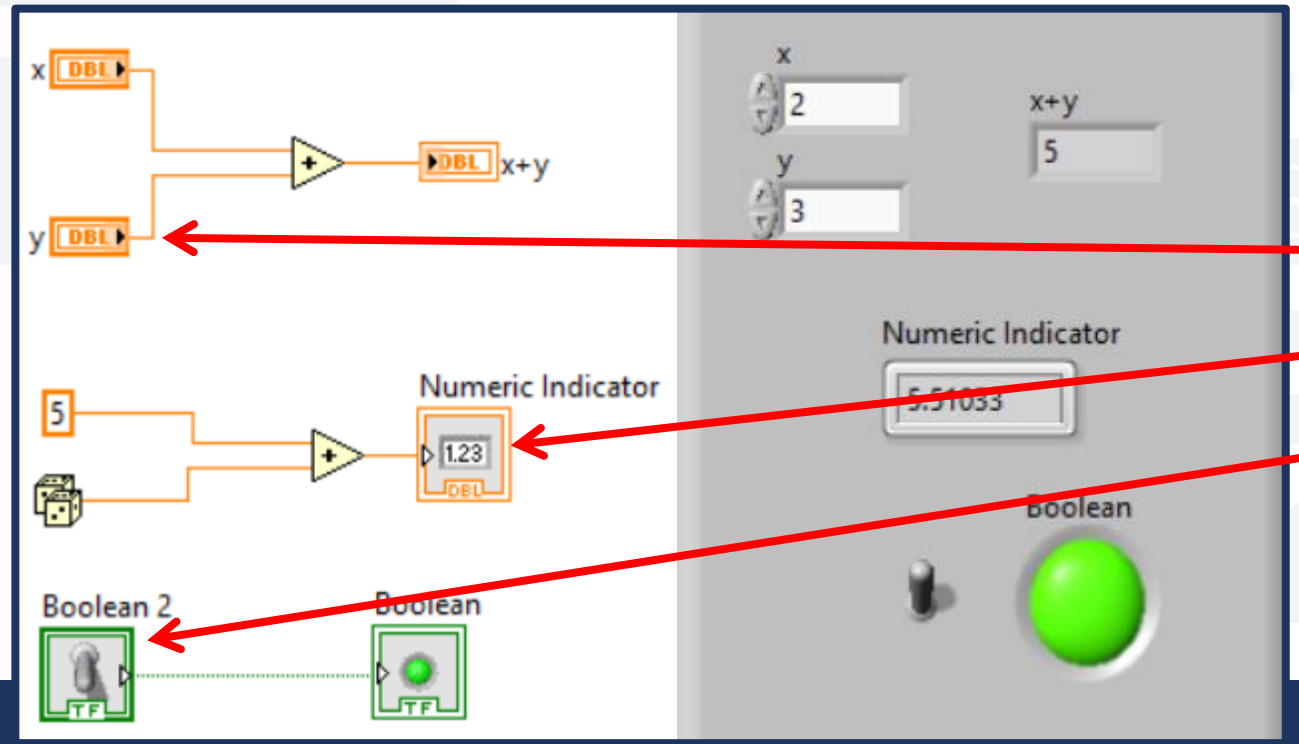


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Il Block Diagram

- Logica del VI tramite **blocchi collegati da fili**.
- **Ogni controllo o indicatore** nel Front Panel **genera un terminale** nel Block Diagram.
- I fili collegano ingressi e uscite e definiscono il flusso dei dati.

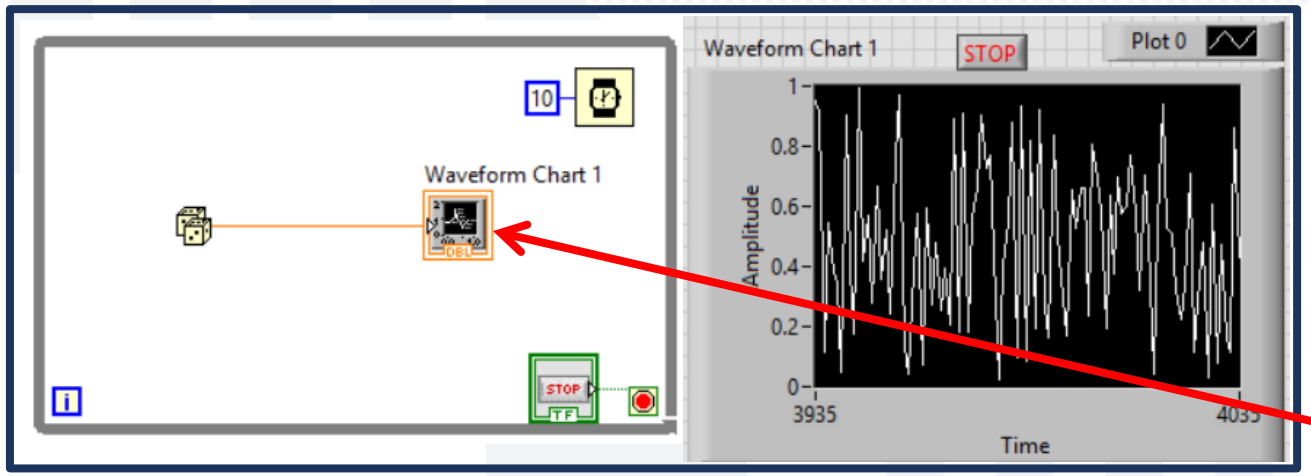


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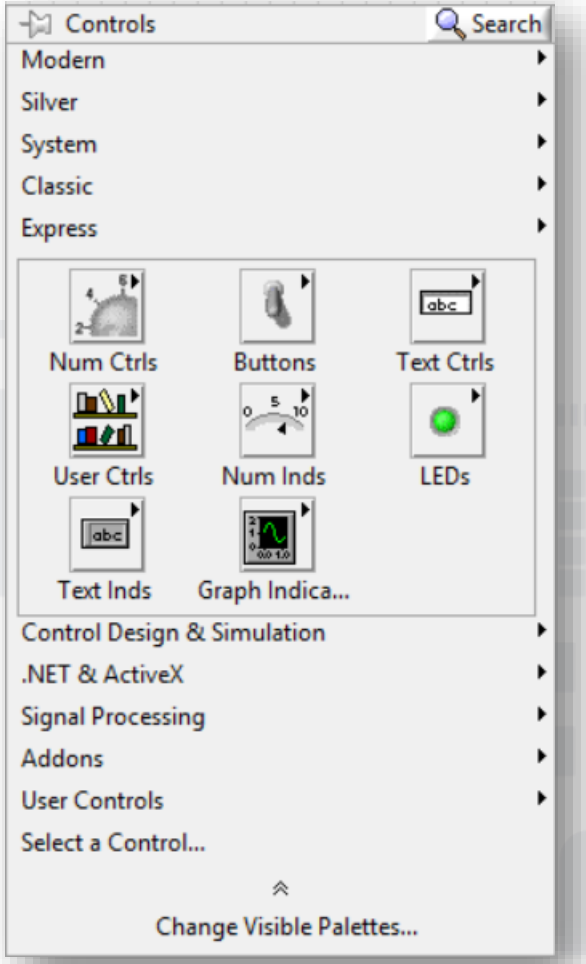
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- Controllo booleano (pulsante On/Off)
- Grafico (segnale nel tempo)

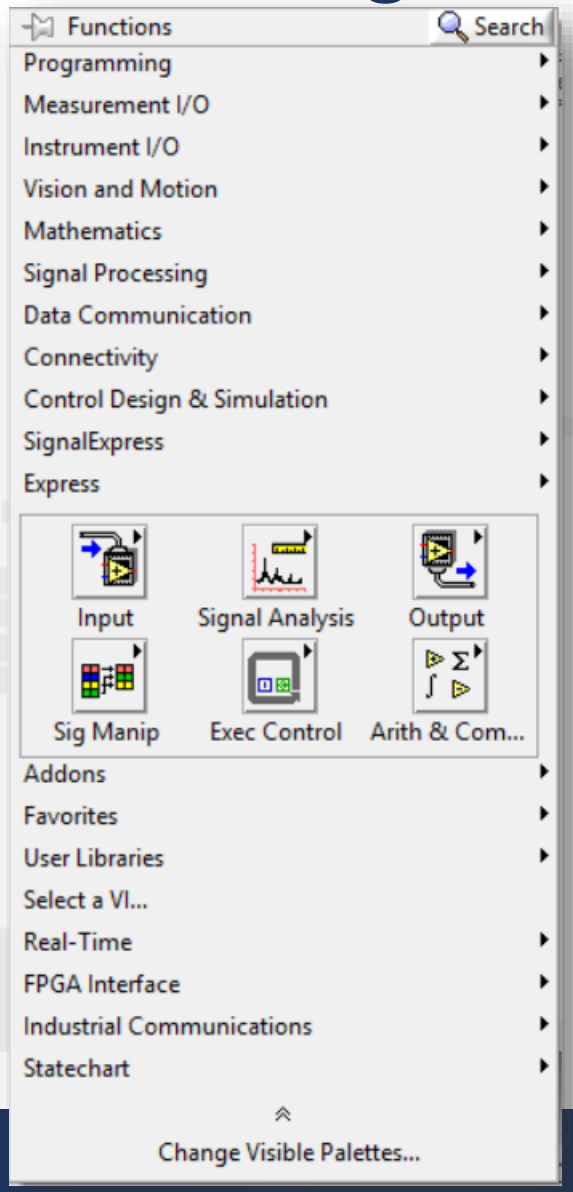
Le palette di LabVIEW: Controls e Functions

Palette

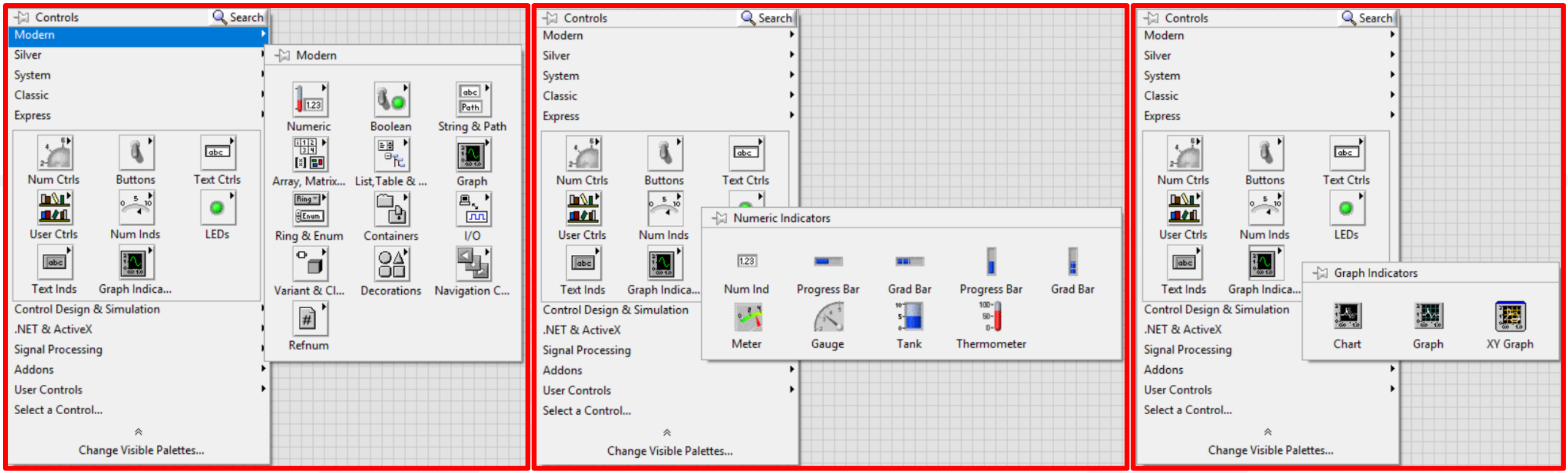
Front Panel



Block Diagram

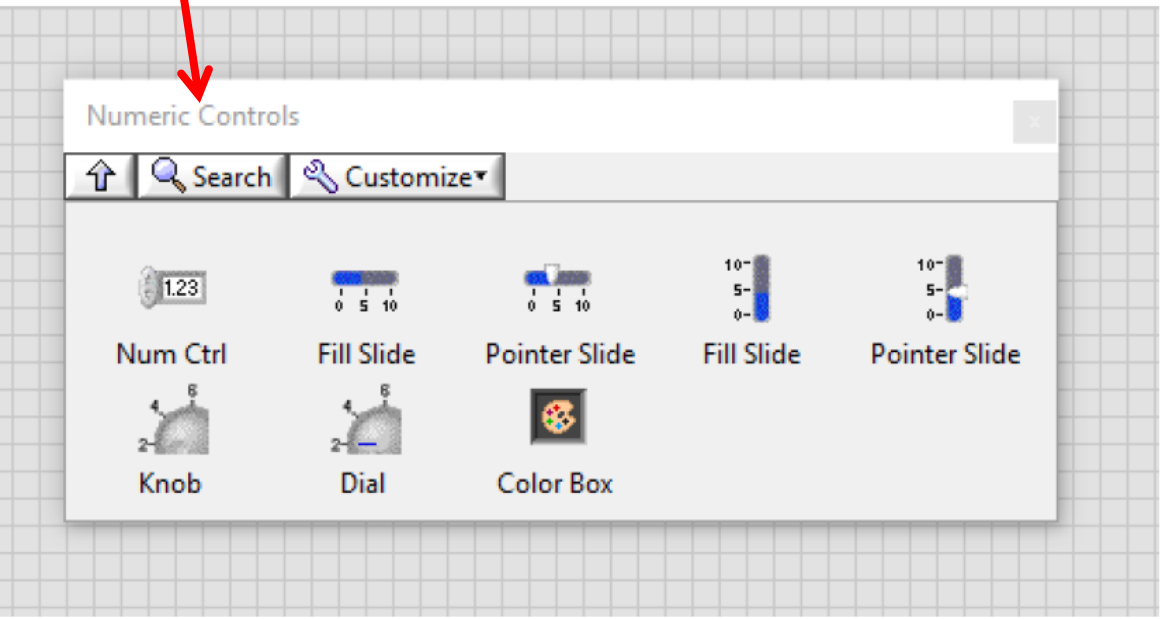


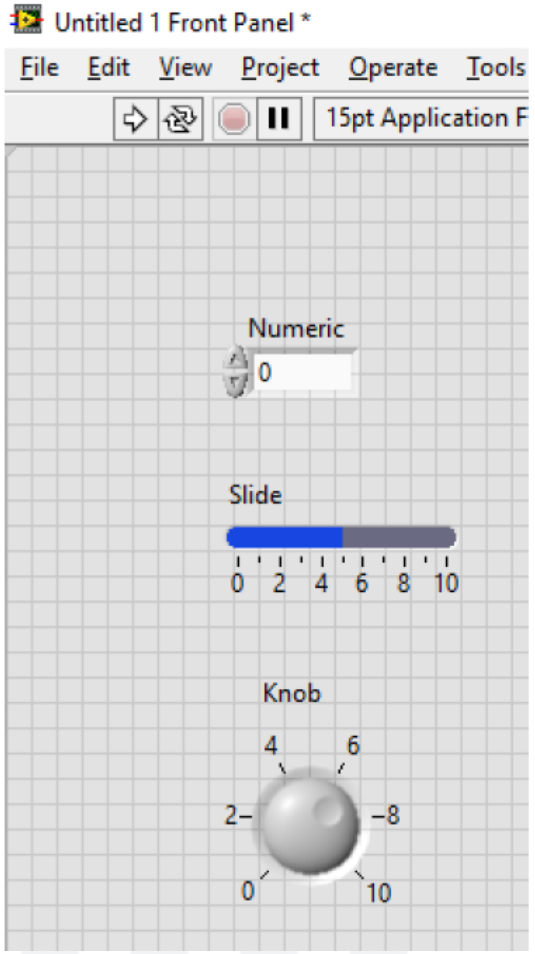
Palette – Front Panel

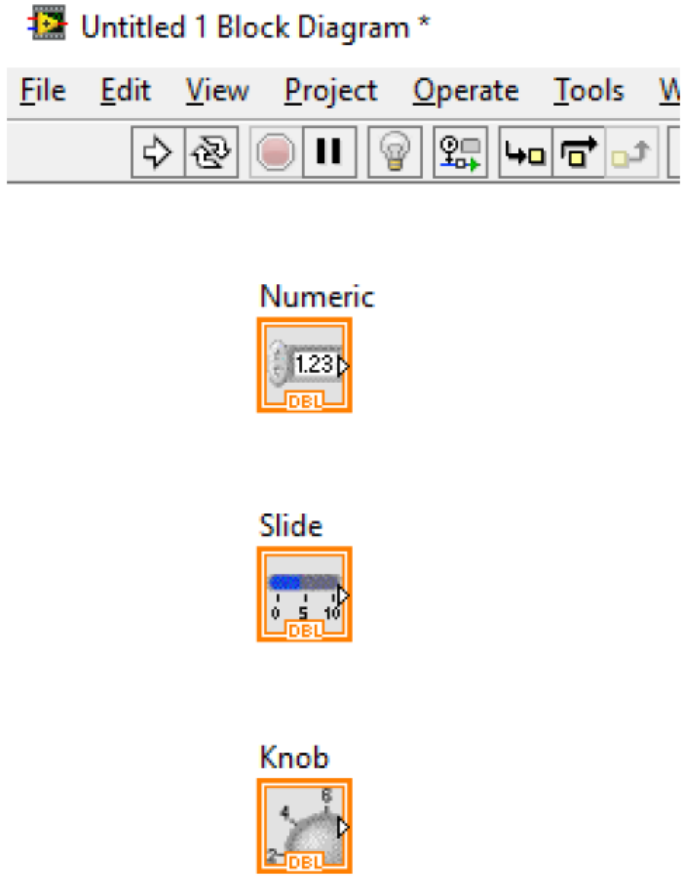


Controlli numerici

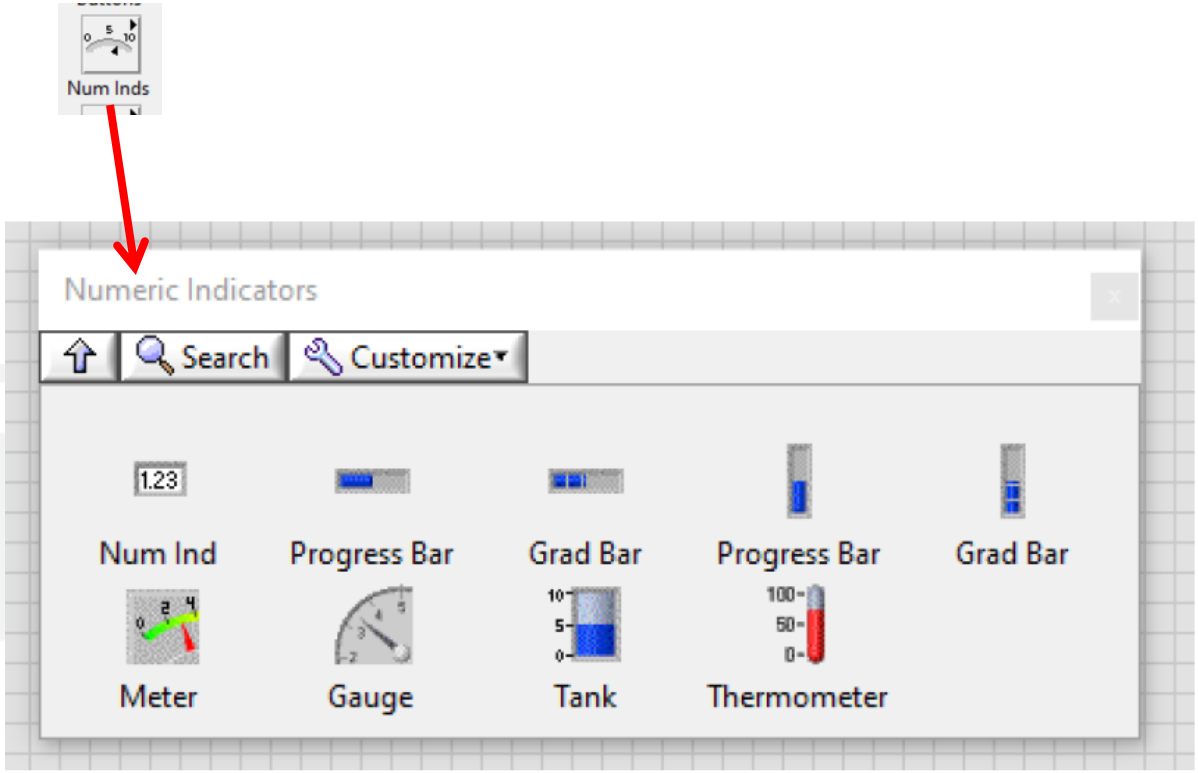


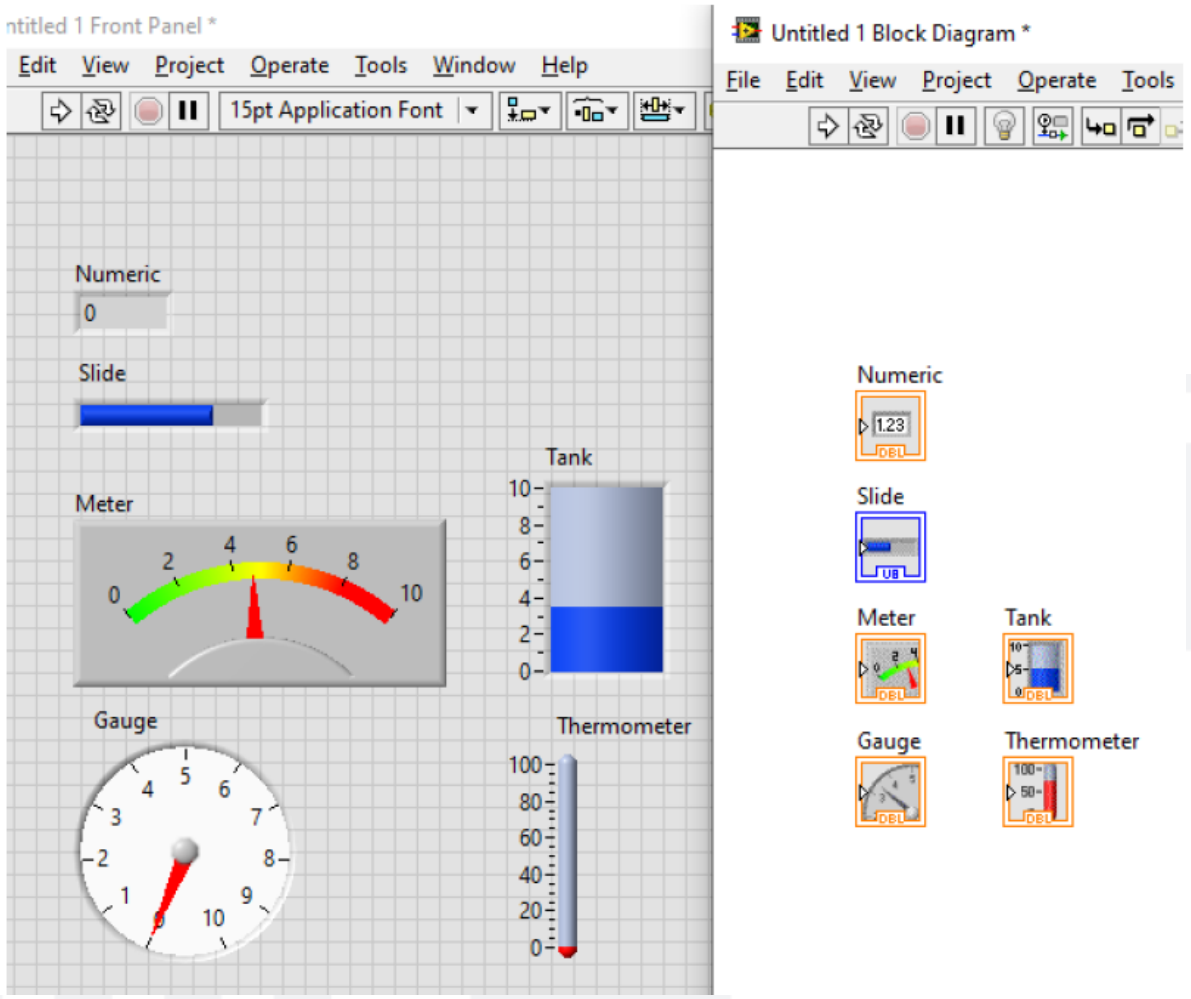






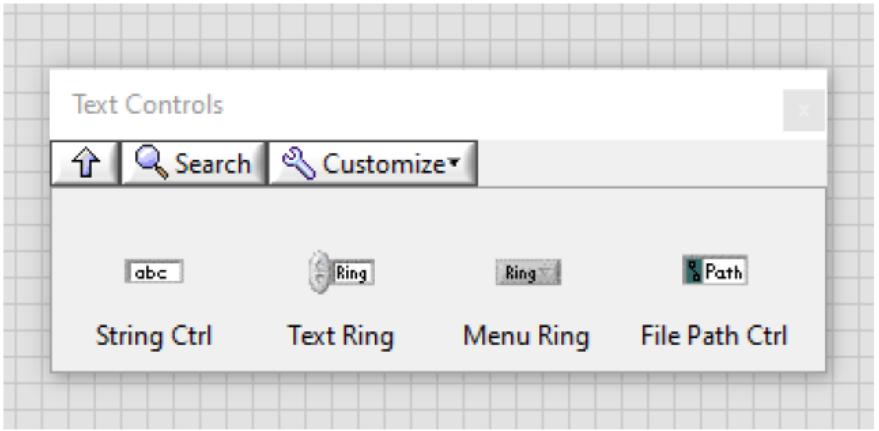
Indicatori numerici

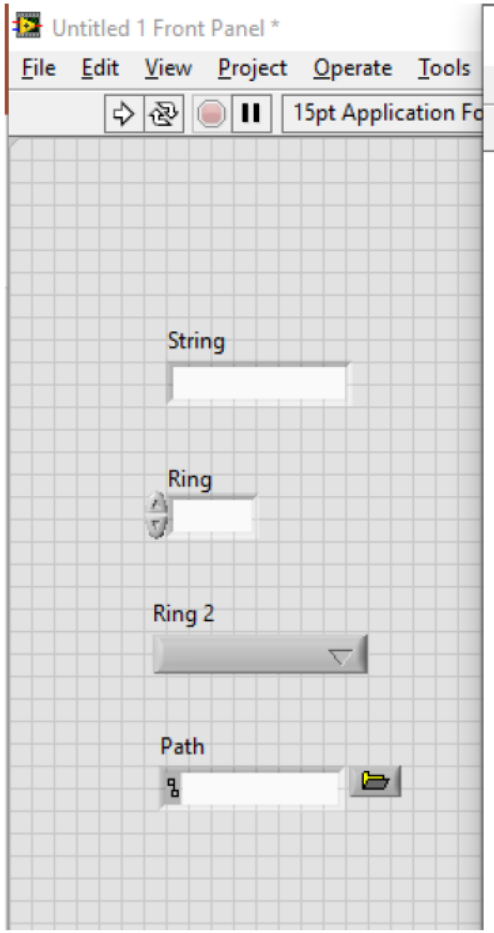


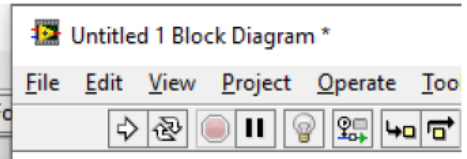


Controlli di Strings

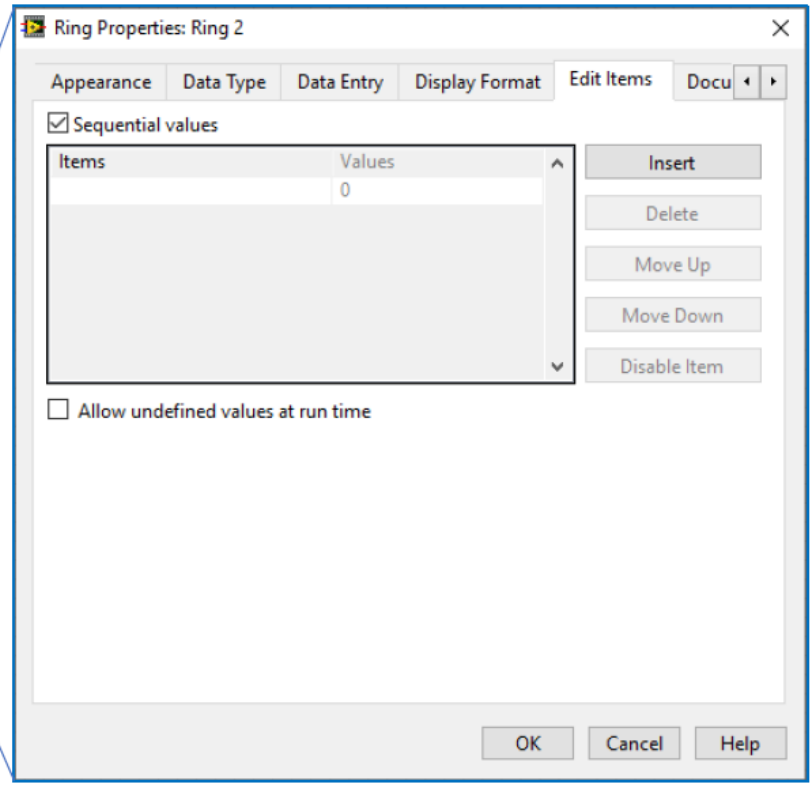




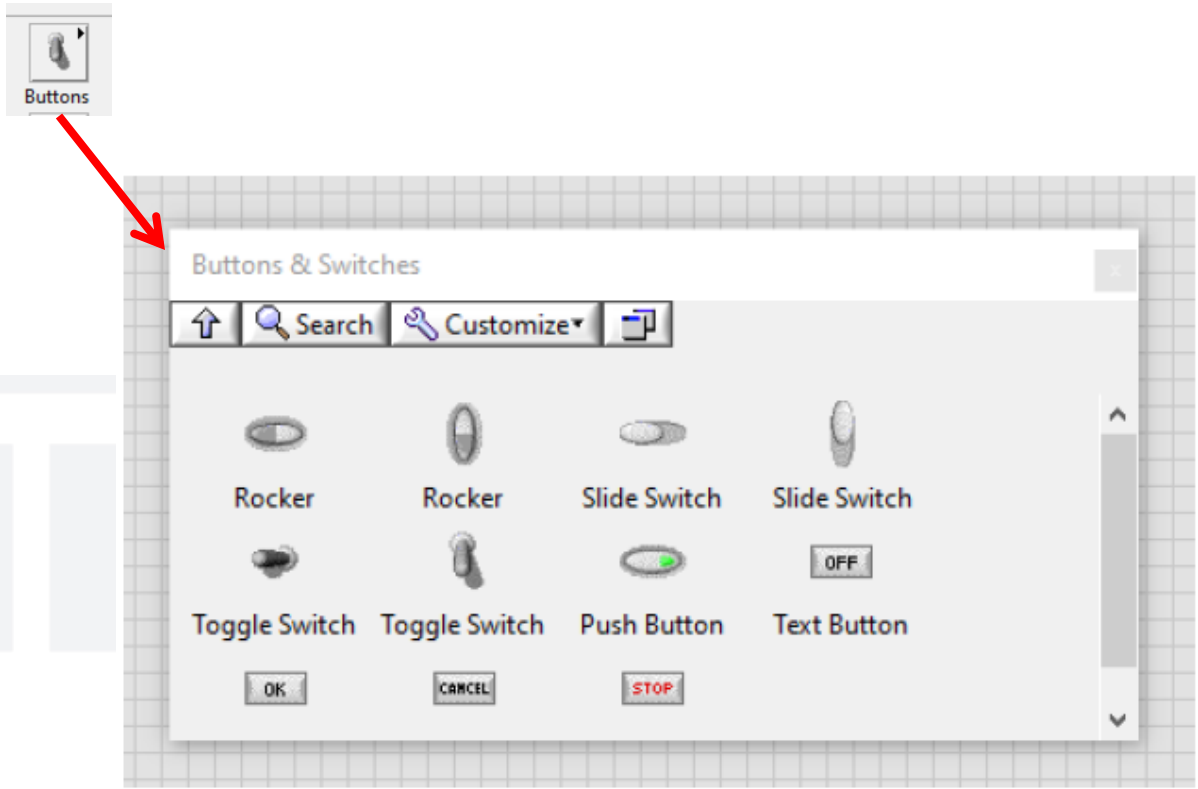


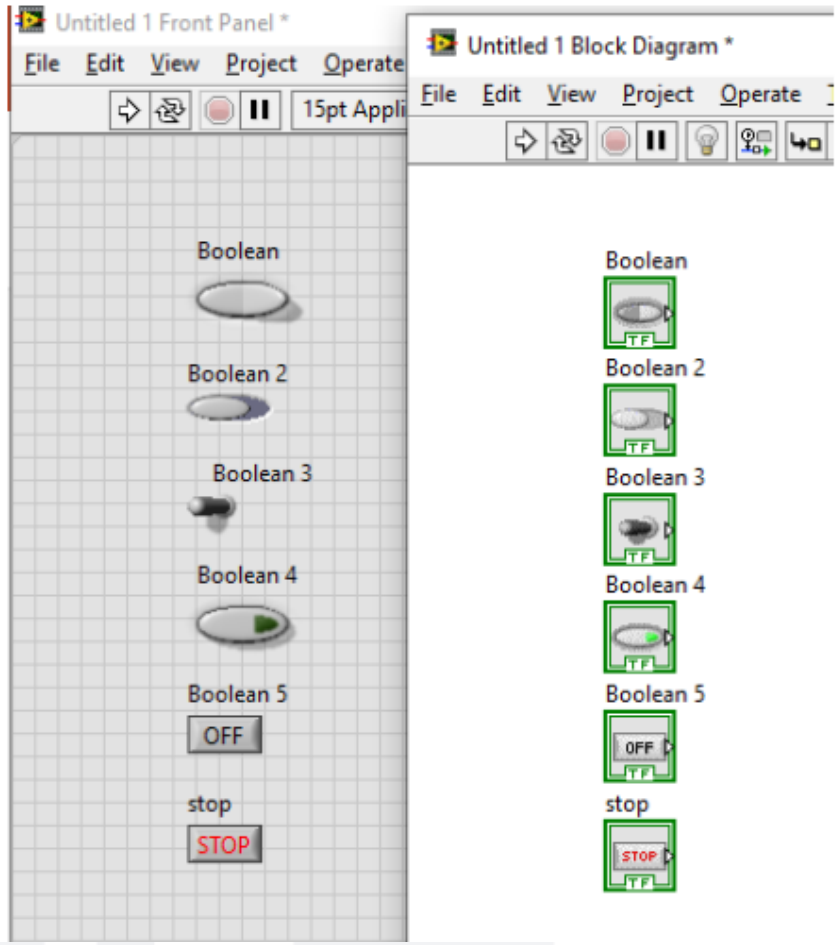




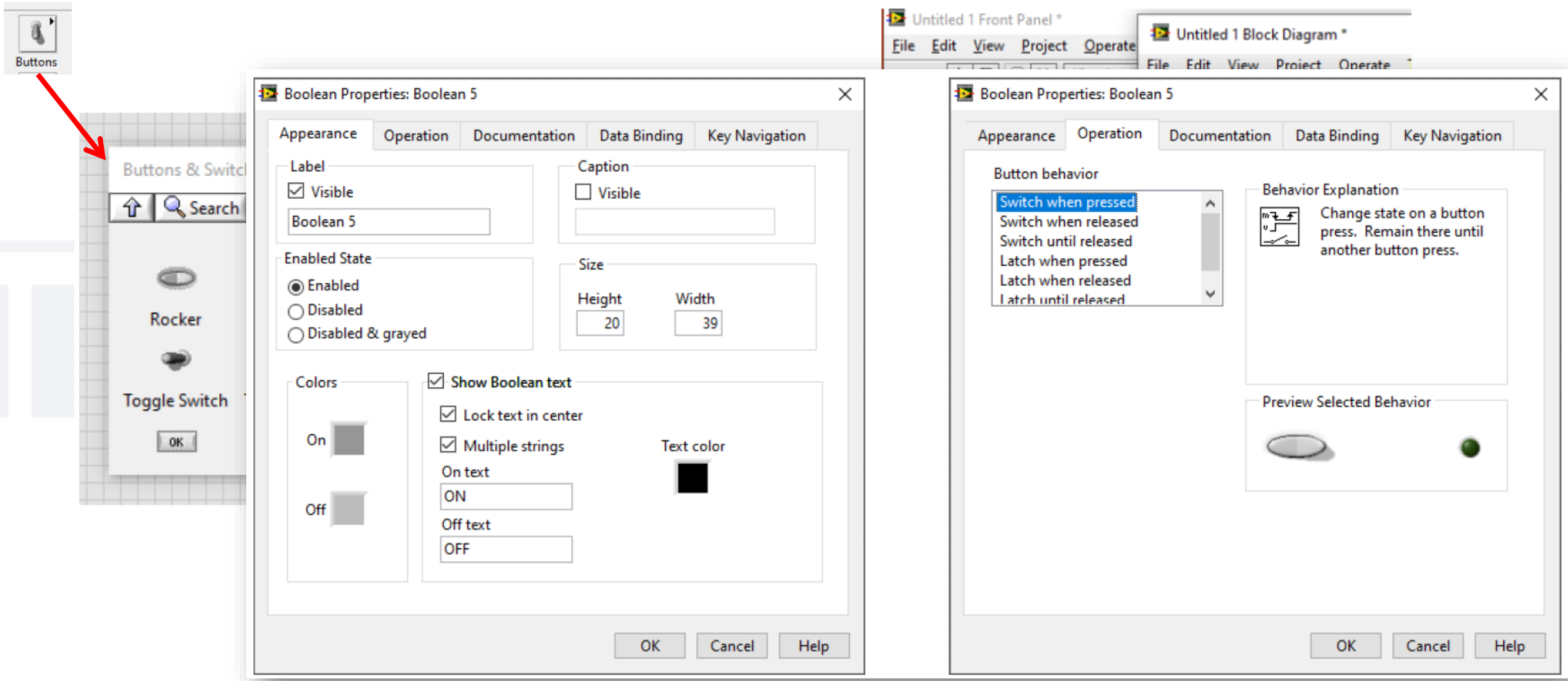


Controlli booleani

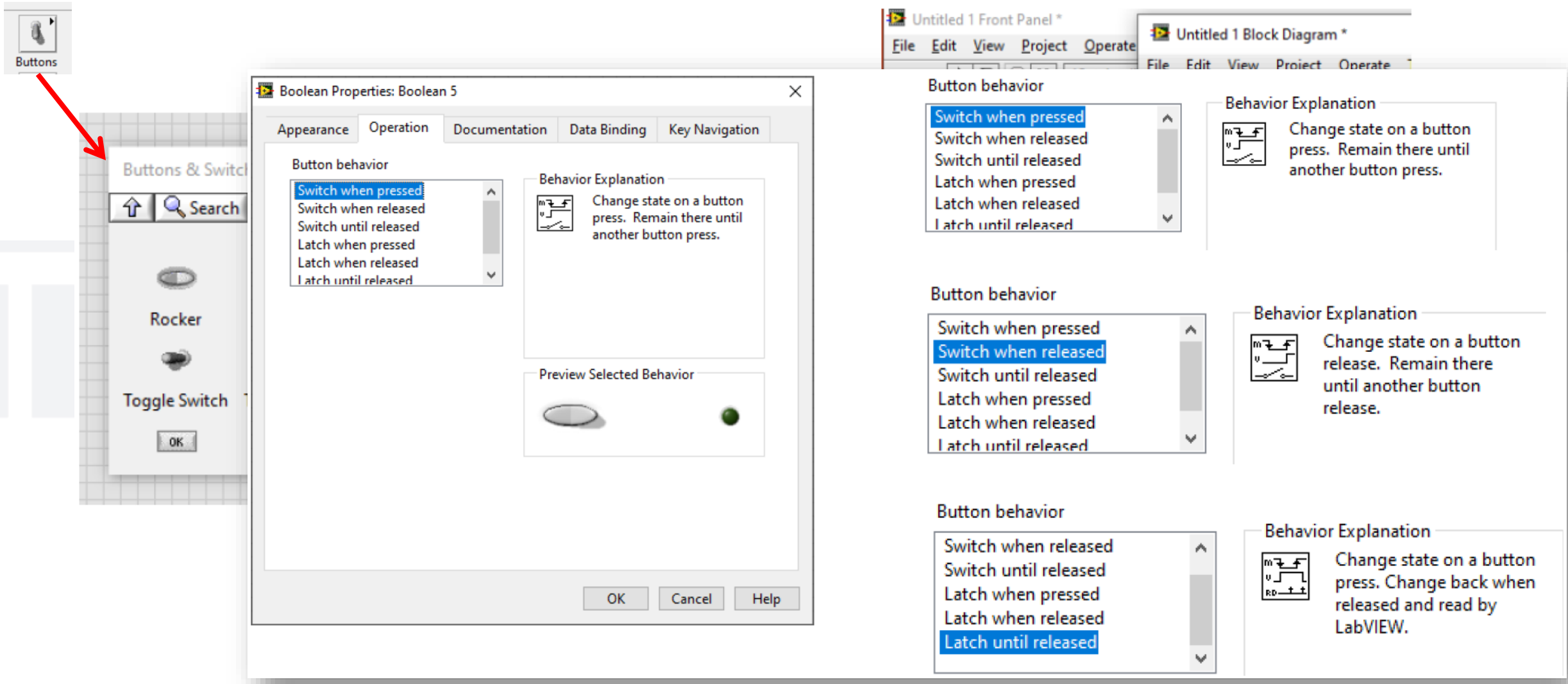




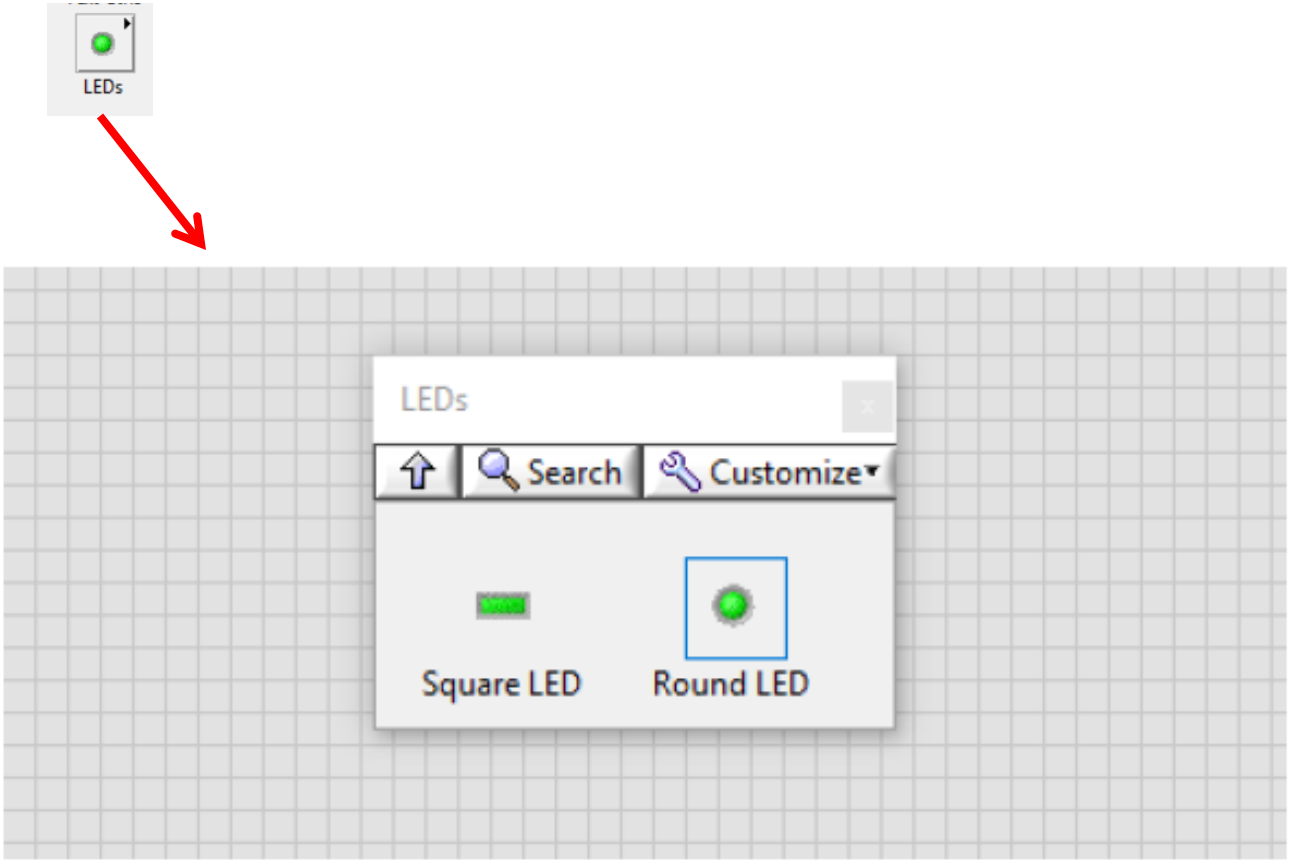
Controlli booleani

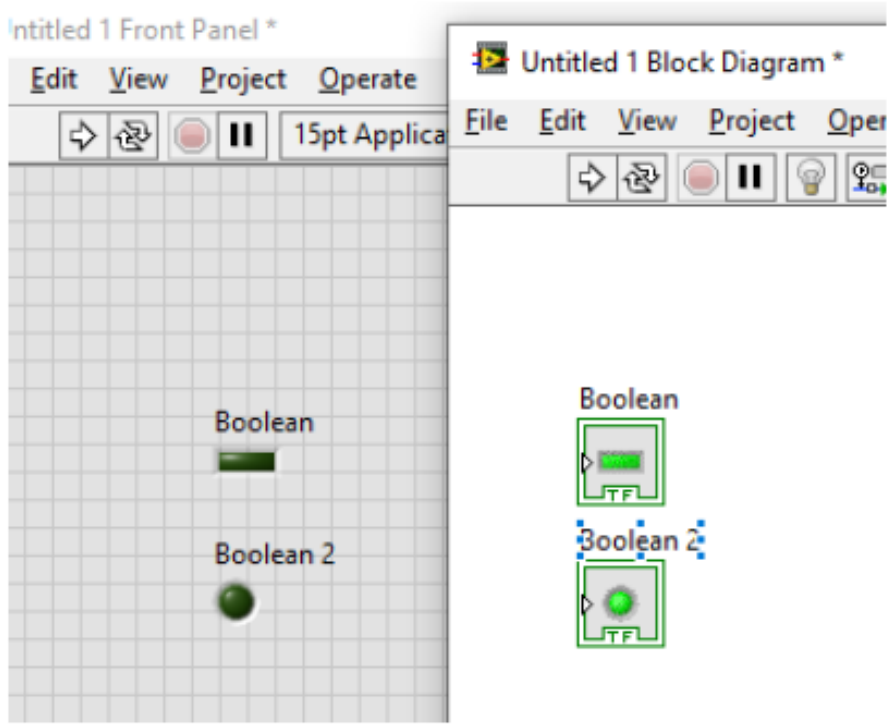


Controlli booleani

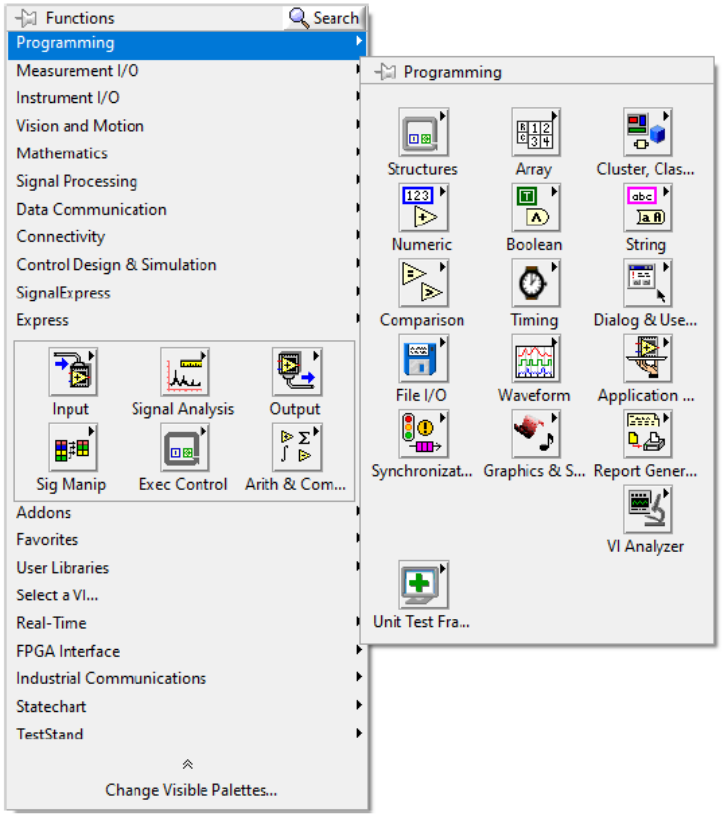


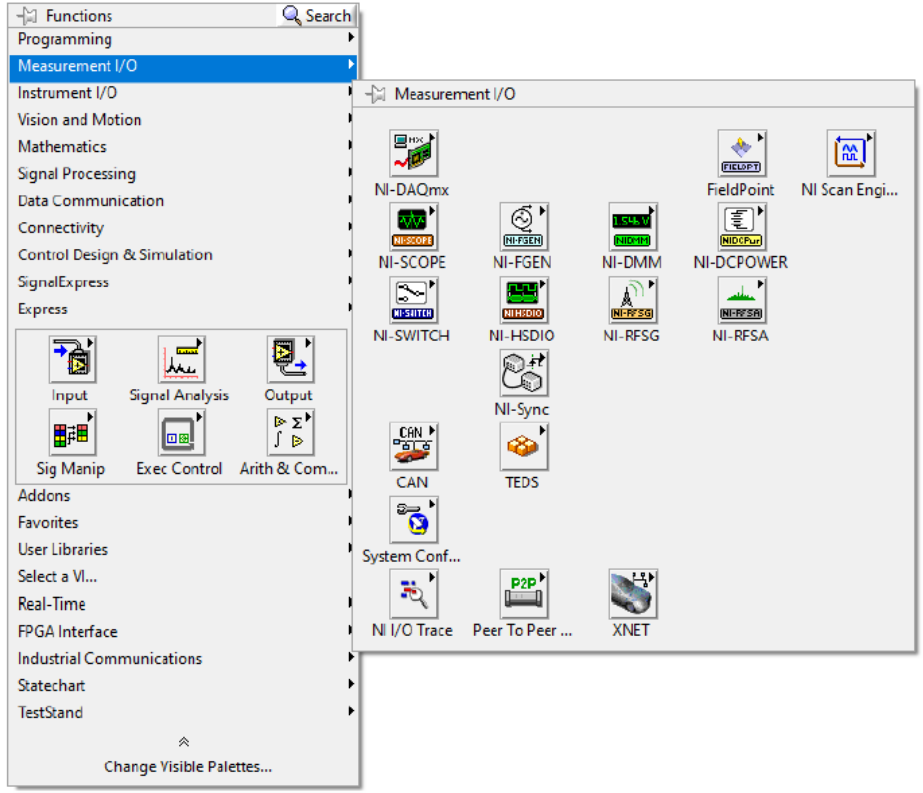
Indicatori booleani

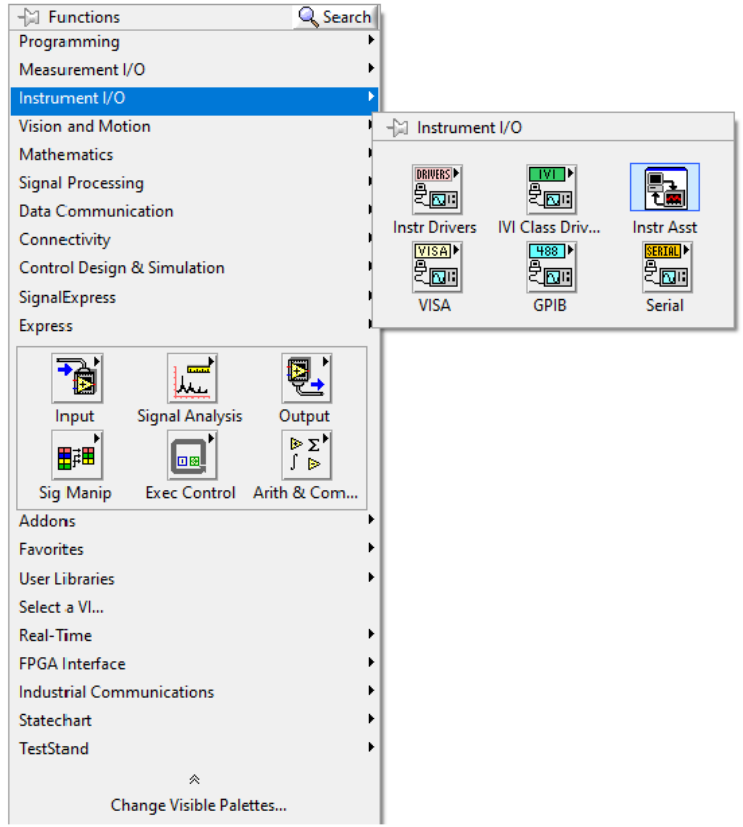




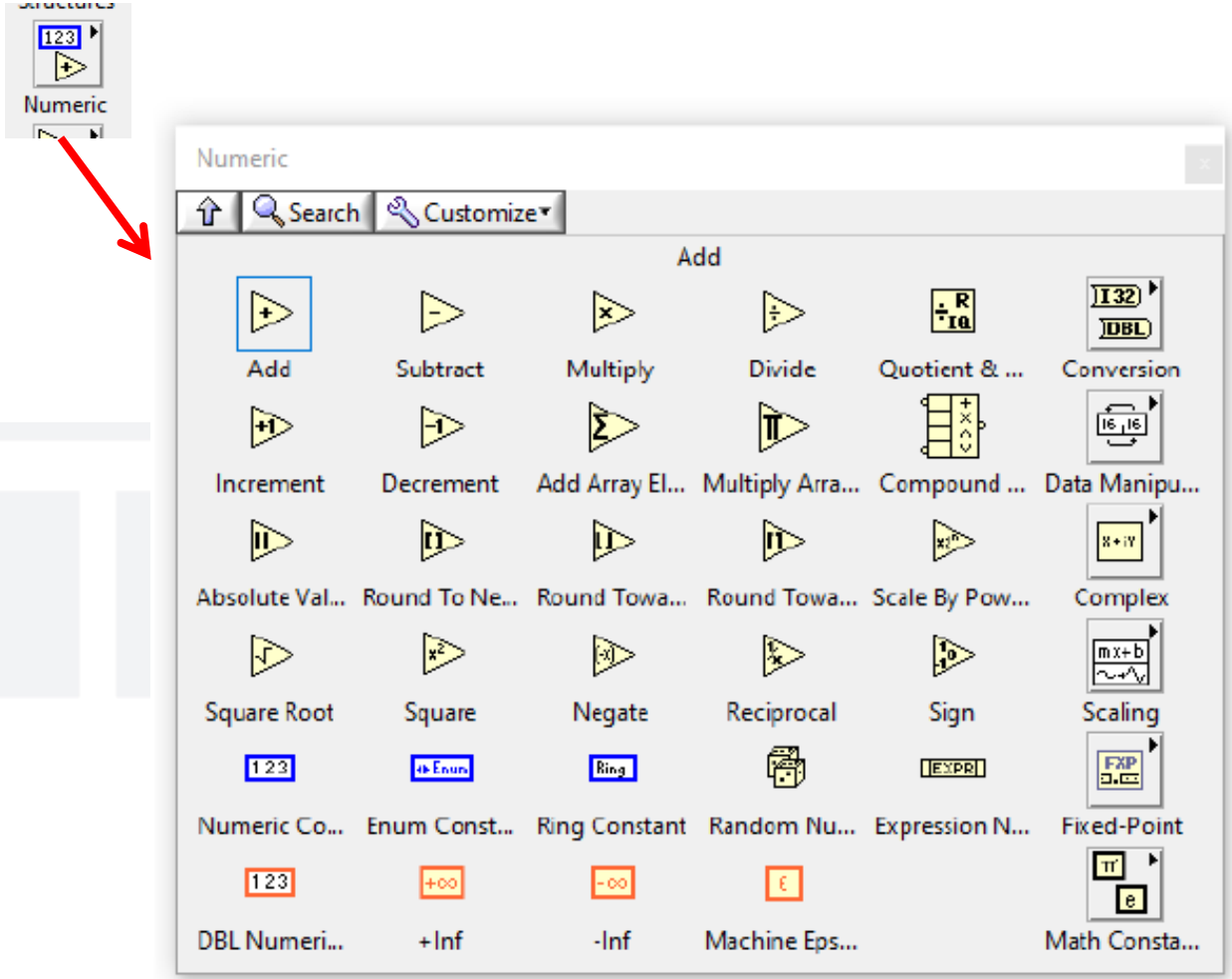
Palette – Block Diagram

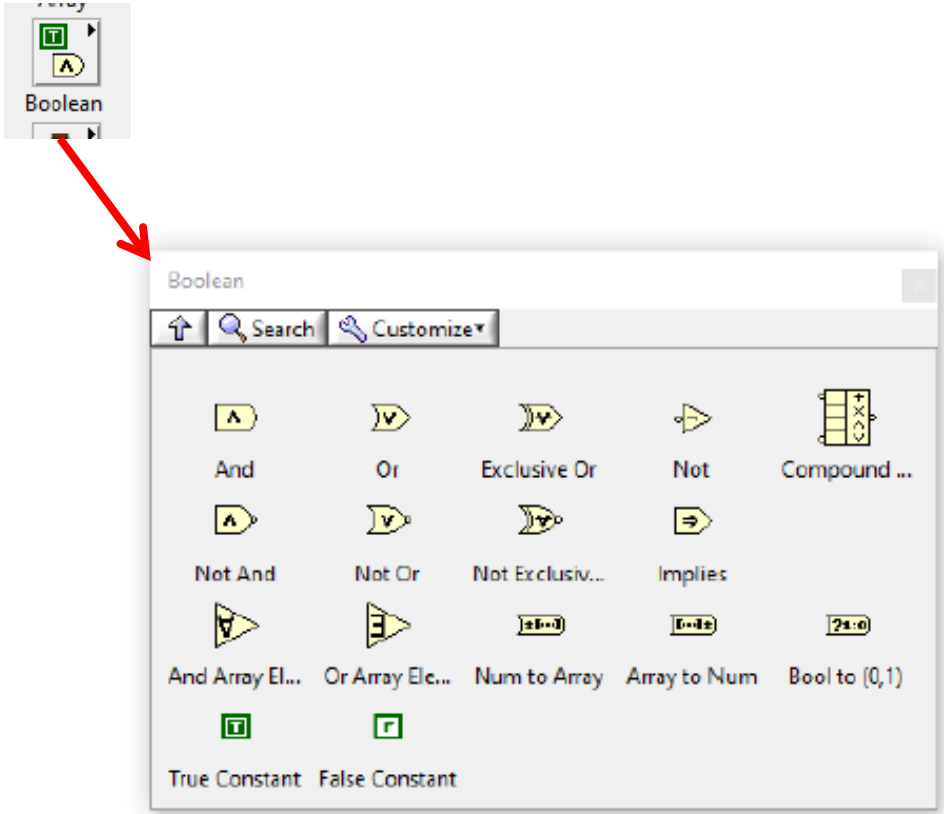




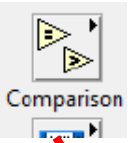


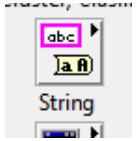
Operazioni

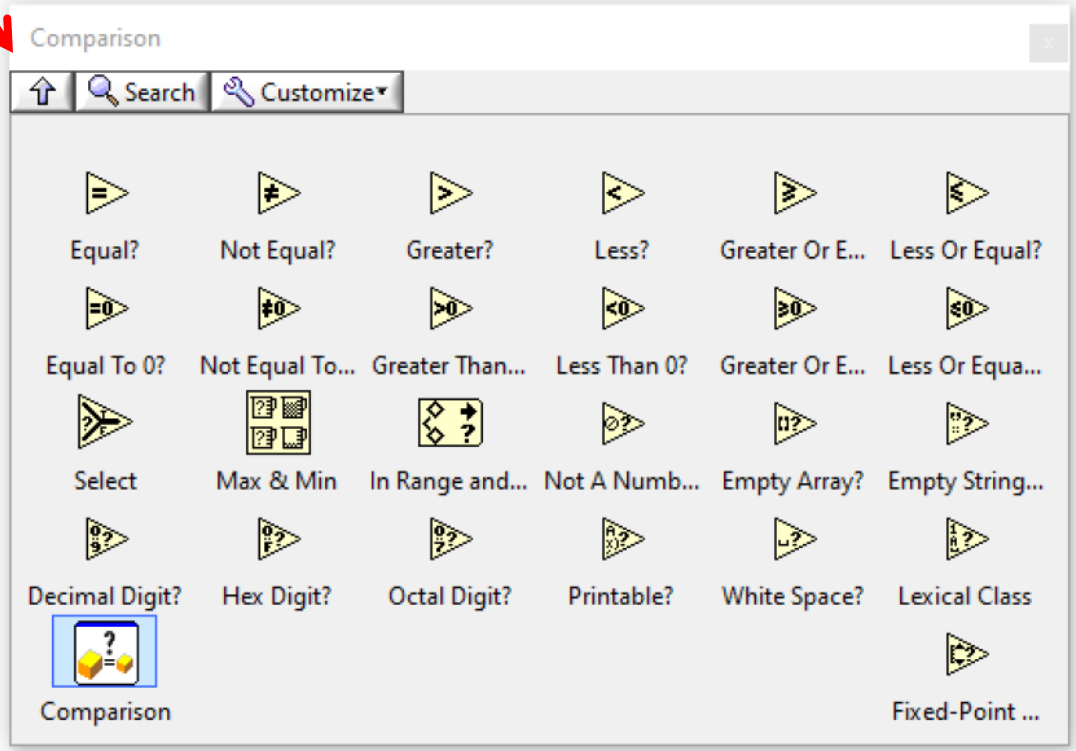

Numeric
Numeric
Search
Customize
Add
Add
Subtract
Multiply
Divide
Quotient & ...
Conversion
Increment
Decrement
Add Array El...
Multiply Arra...
Compound ...
Data Manipu...
Absolute Val...
Round To Ne...
Round Towa...
Round Towa...
Scale By Pow...
Complex
Square Root
Square
Negate
Reciprocal
Sign
Scaling
Numeric Co...
Enum Const...
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Fixed-Point
DBL Numeri...
+Inf
-Inf
Machine Eps...
Math Consta...

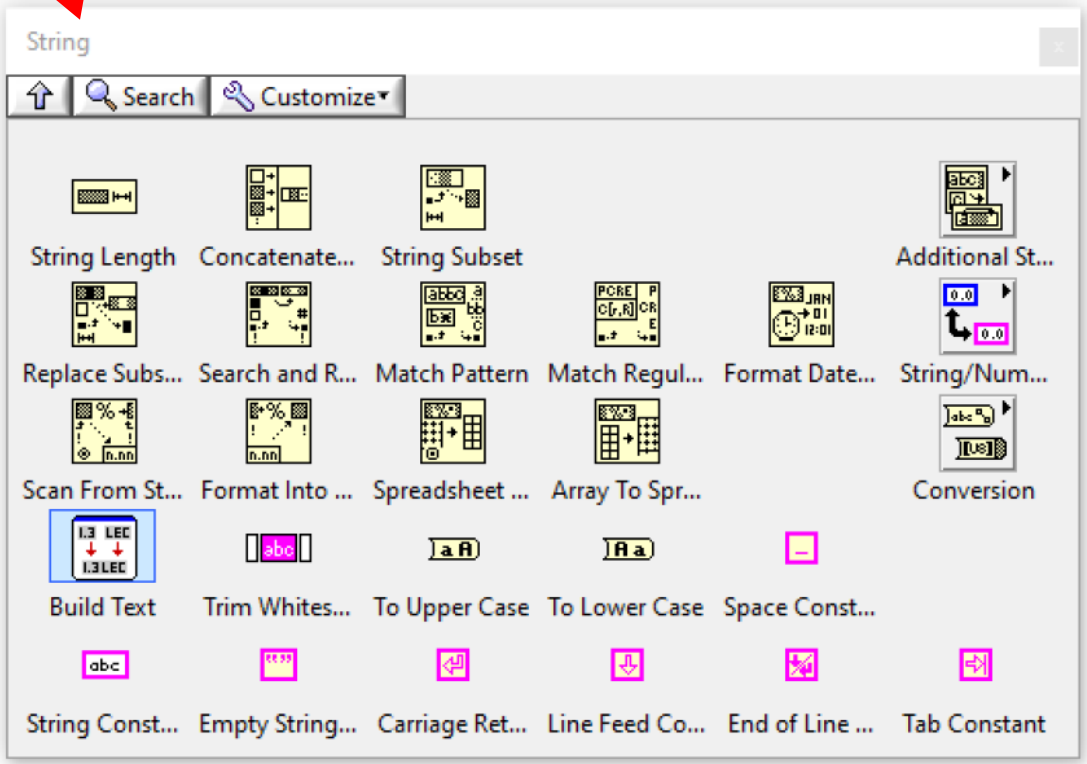

Boolean
Boolean
Search
Customize
And
Or
Exclusive Or
Not
Compound ...
Not And
Not Or
Not Exclusiv...
Implies
And Array El...
Or Array Ele...
Num to Array
Array to Num
Bool to (0,1)
True Constant
False Constant

Operazioni

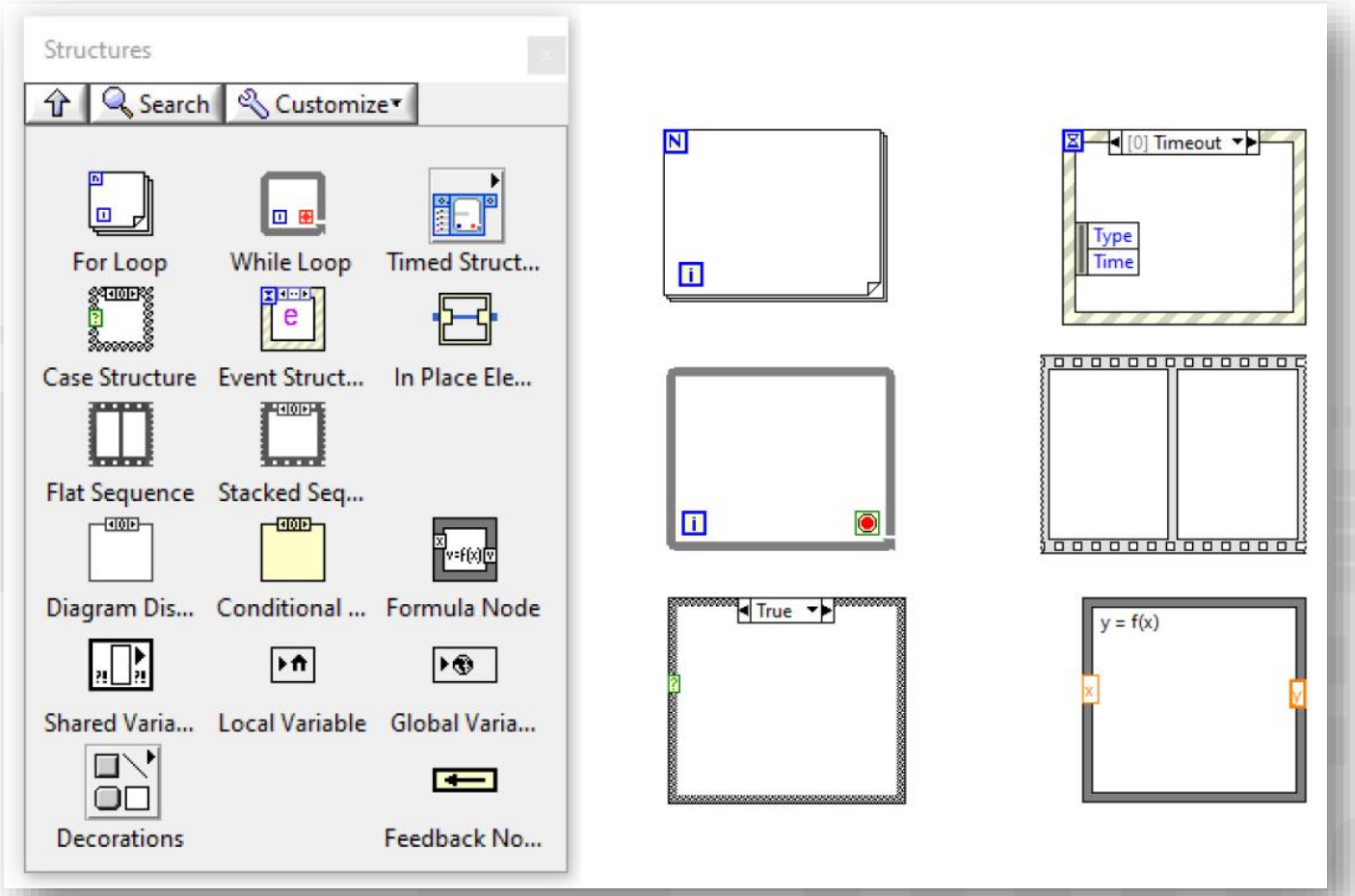

Comparison

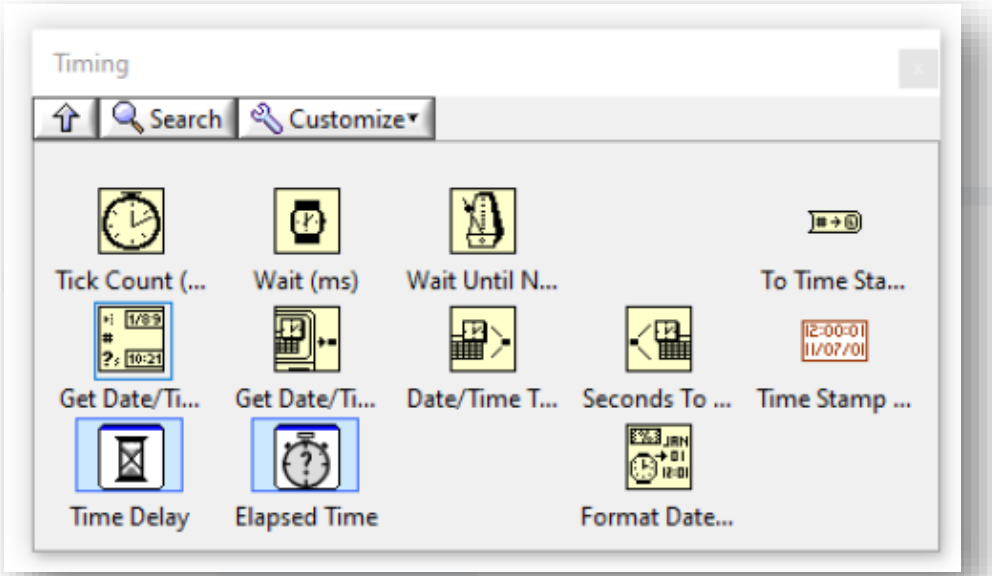

String


Comparison
Search
Customize
Equal?
Not Equal?
Greater?
Less?
Greater Or E...
Less Or Equal?
Equal To 0?
Not Equal To...
Greater Than...
Less Than 0?
Greater Or E...
Less Or Equa...
Select
Max & Min
In Range and...
Not A Numb...
Empty Array?
Empty String...
Decimal Digit?
Hex Digit?
Octal Digit?
Printable?
White Space?
Lexical Class
Comparison
Fixed-Point ...

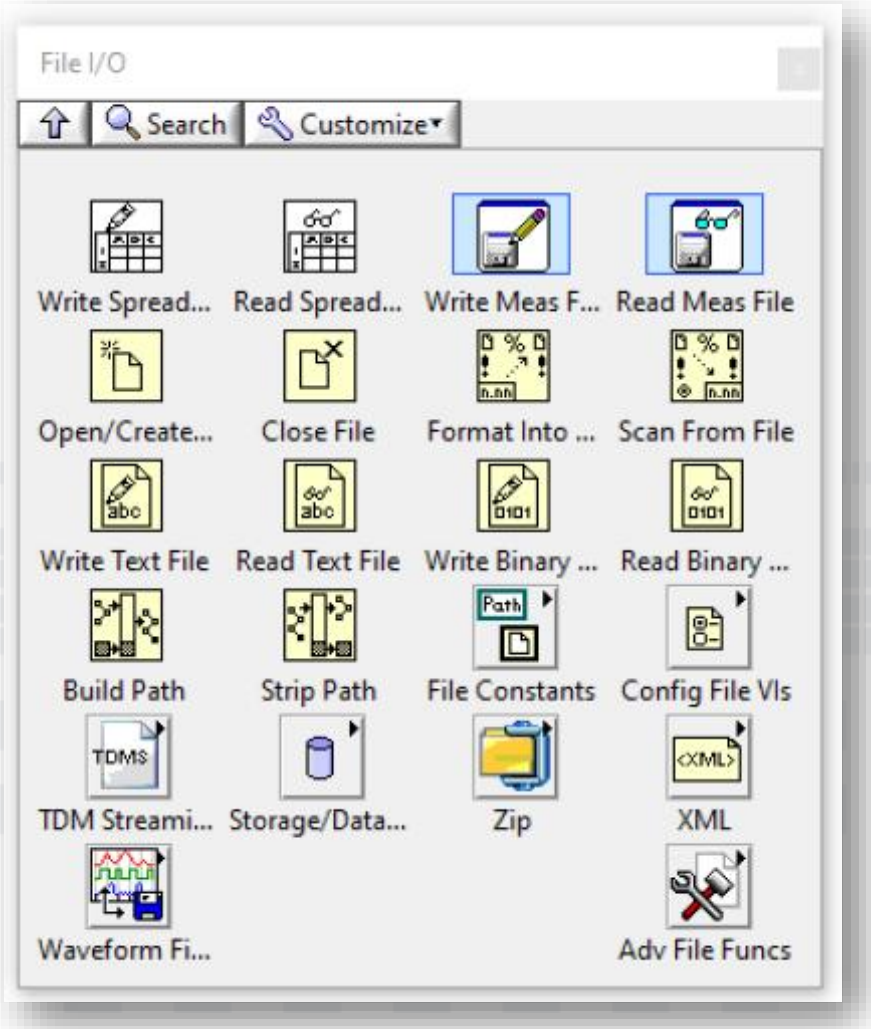

String
Search
Customize
String Length
Concatenate...
String Subset
Additional St...
Replace Subs...
Search and R...
Match Pattern
Match Regul...
Format Date...
String/Num...
Scan From St...
Format Into ...
Spreadsheet ...
Array To Spr...
Conversion
Build Text
Trim Whites...
To Upper Case
To Lower Case
Space Const...
String Const...
Empty String...
Carriage Ret...
Line Feed Co...
End of Line ...
Tab Constant

Structures and Timing

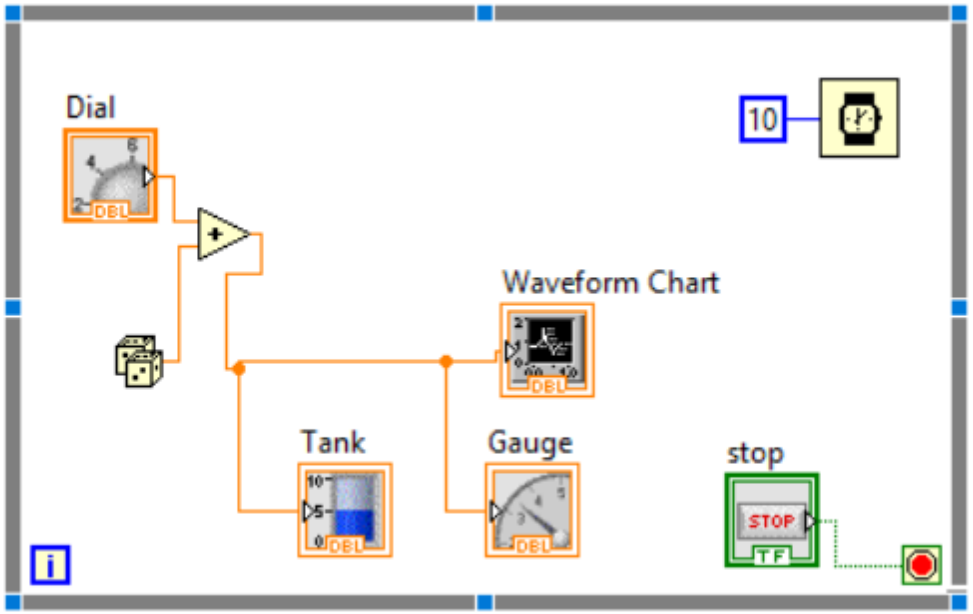


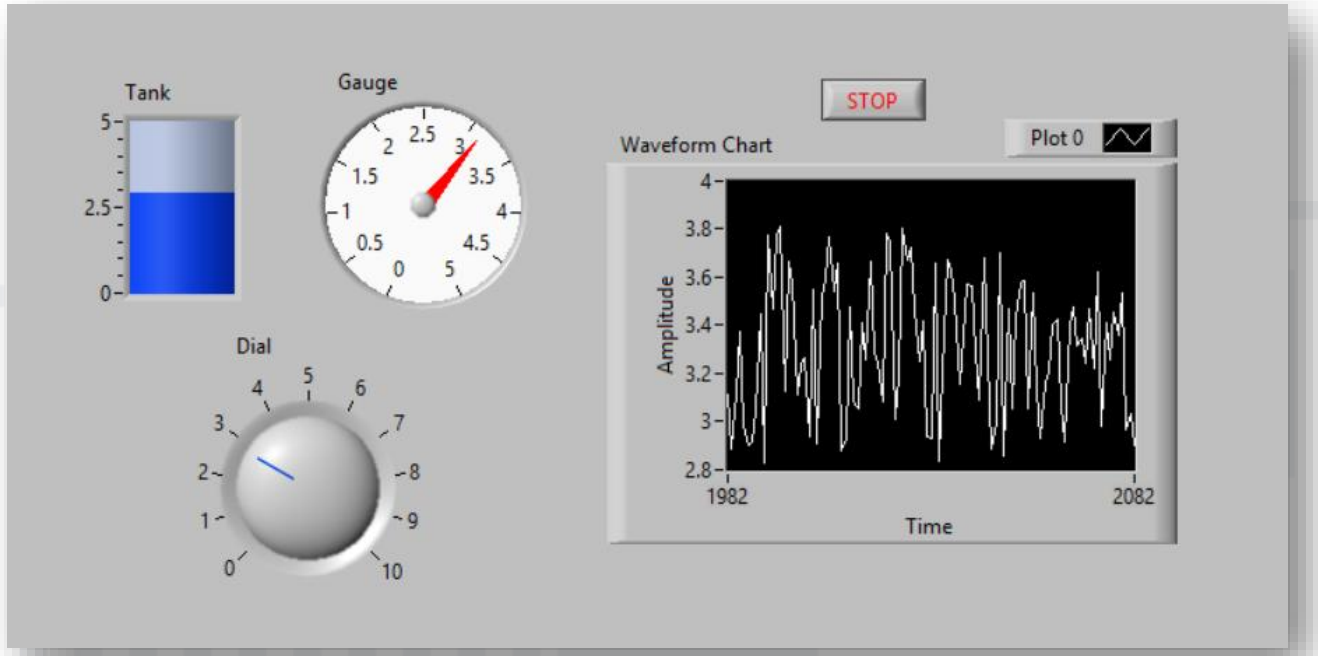


File I/O


File I/O
Search
Customize
Write Spread...
Read Spread...
Write Meas F...
Read Meas File
Open/Create...
Close File
Format Into ...
Scan From File
Write Text File
Read Text File
Write Binary ...
Read Binary ...
Build Path
Strip Path
File Constants
Config File Vls
TDM Streami...
Storage/Data...
Zip
XML
Waveform Fi...
Adv File Funcs

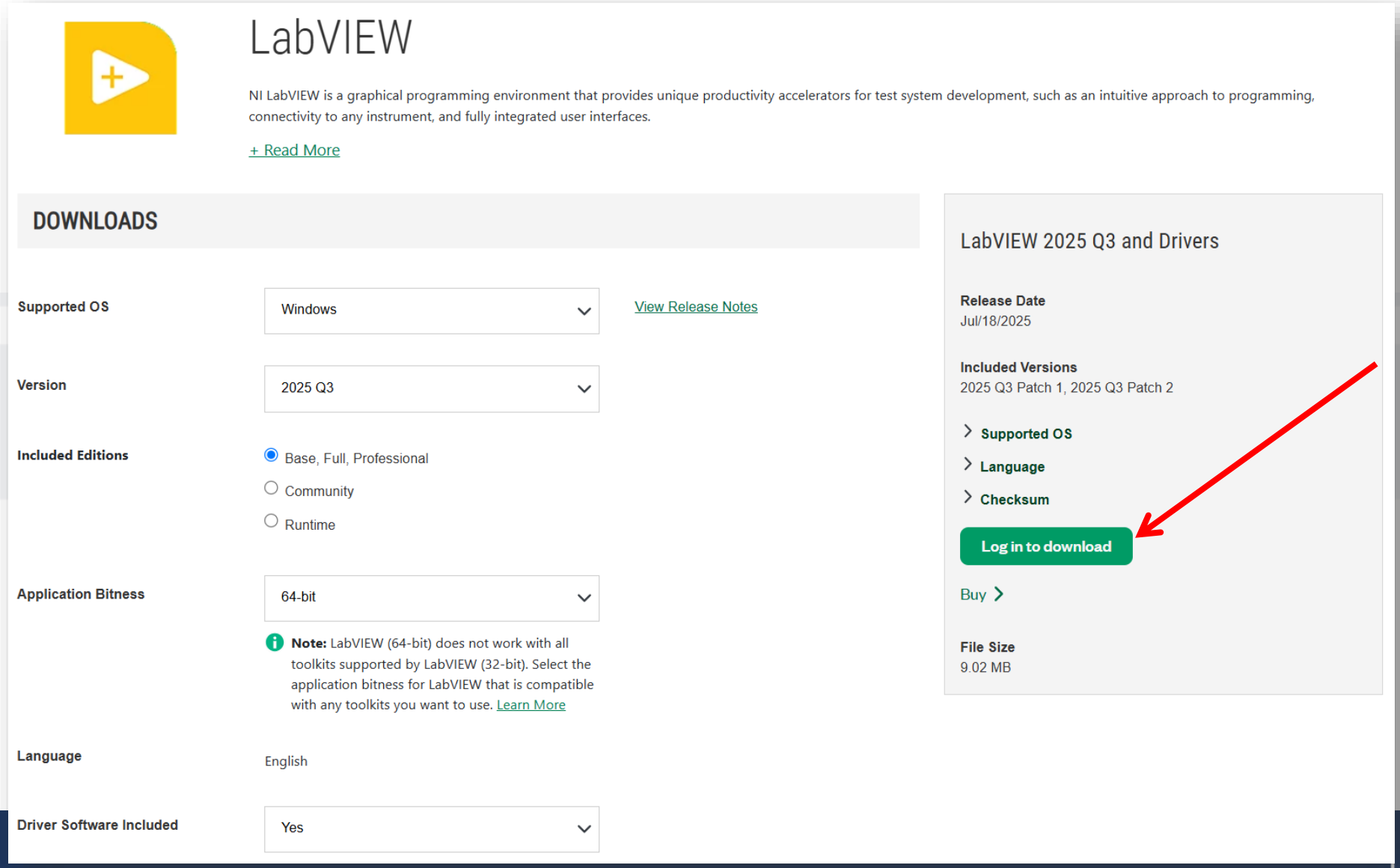
Esempio


Dial
10
Waveform Chart
Tank
Gauge
stop
STOP
TF

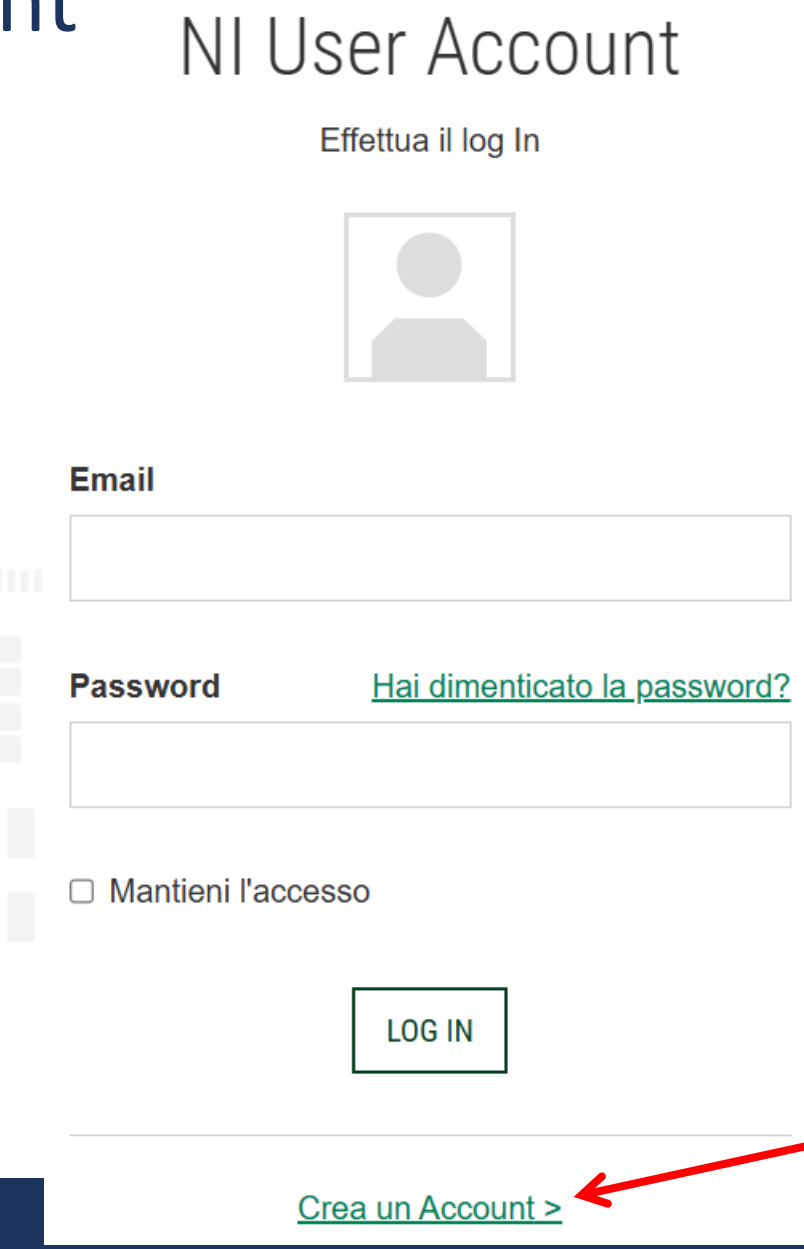

Tank
Gauge
STOP
Waveform Chart
Plot 0
Dial
Amplitude
Time
1982
2082

Installazione del LabVIEW

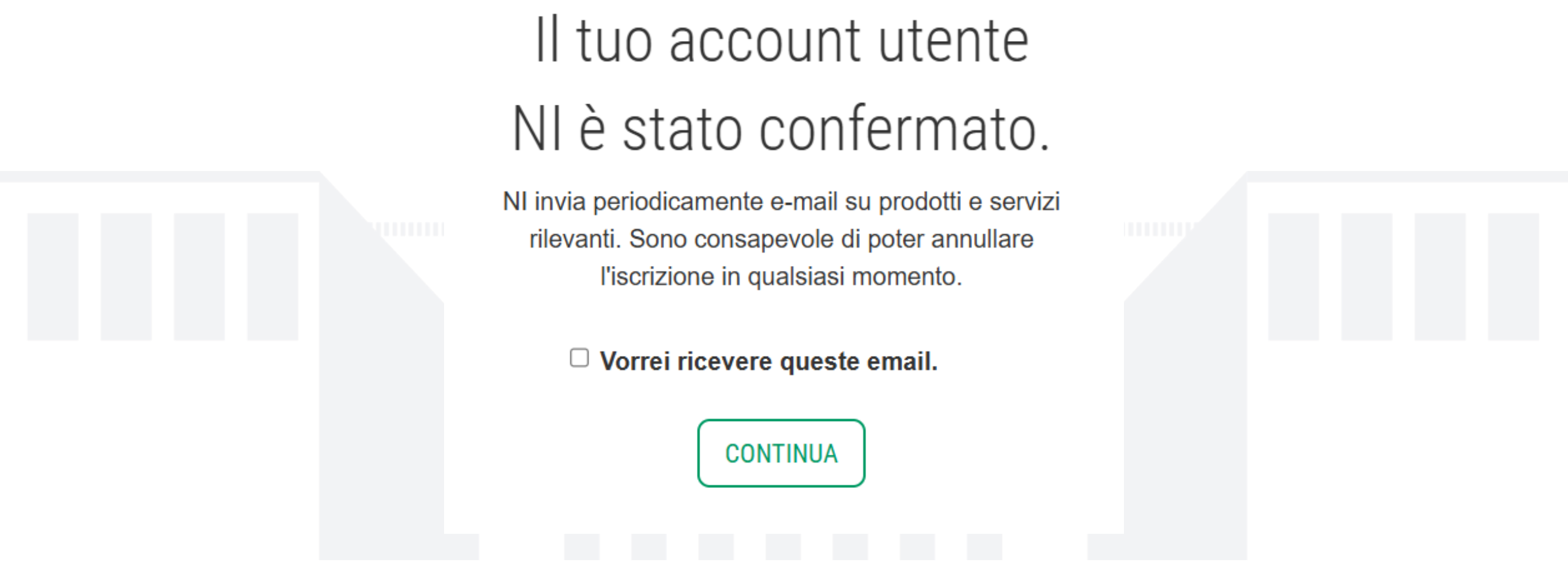
Versione da installare



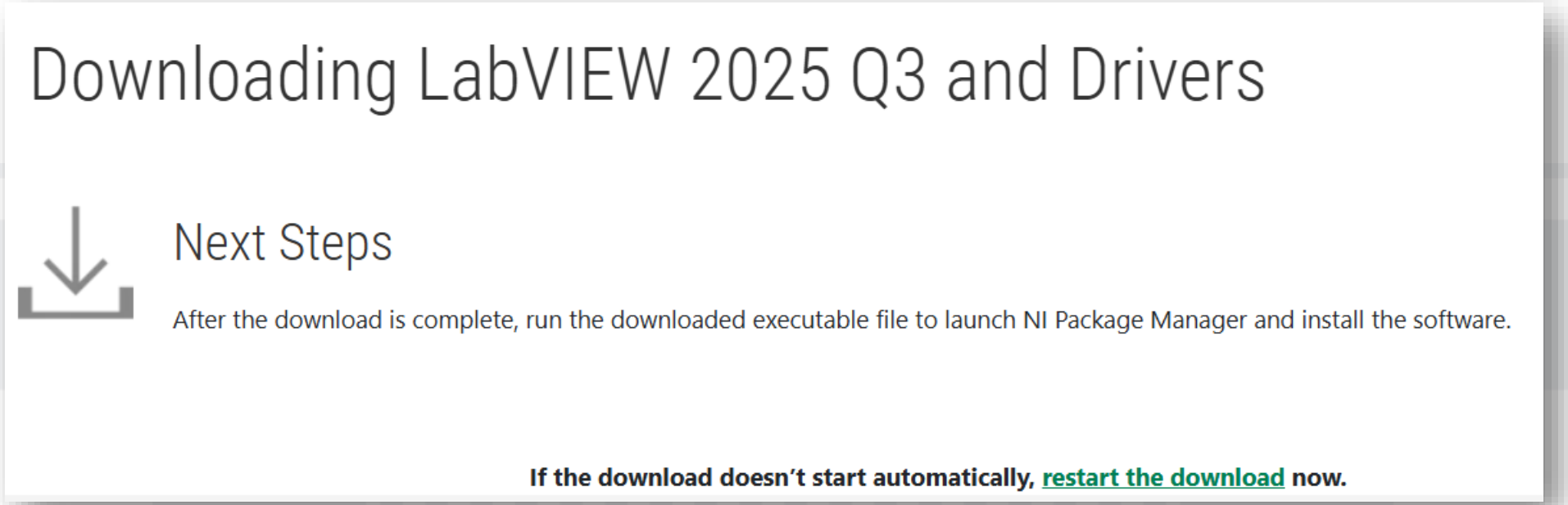
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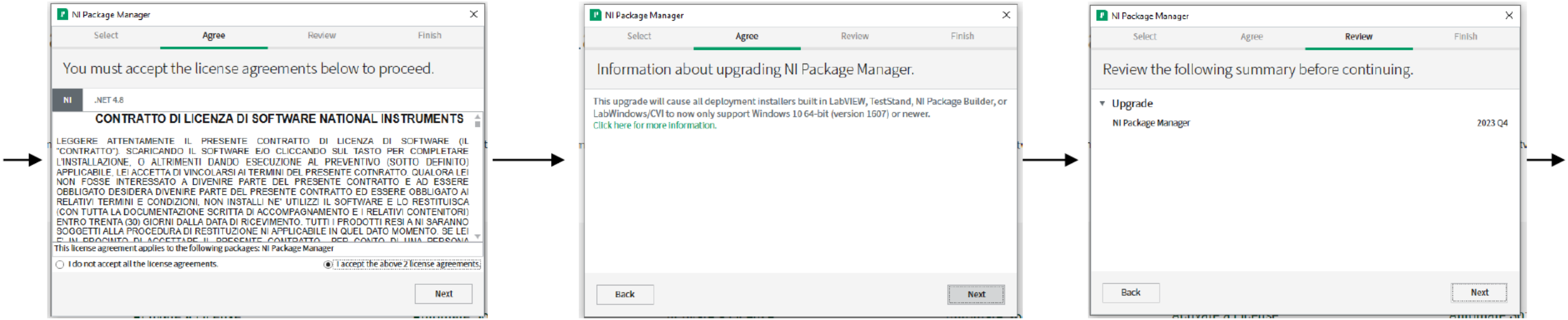
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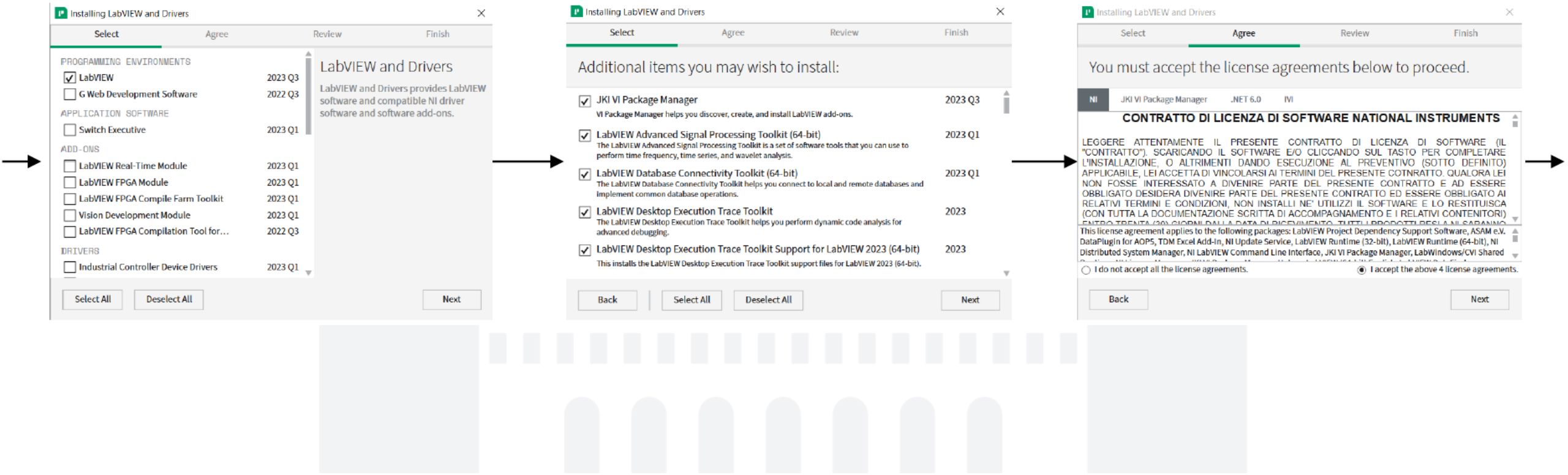
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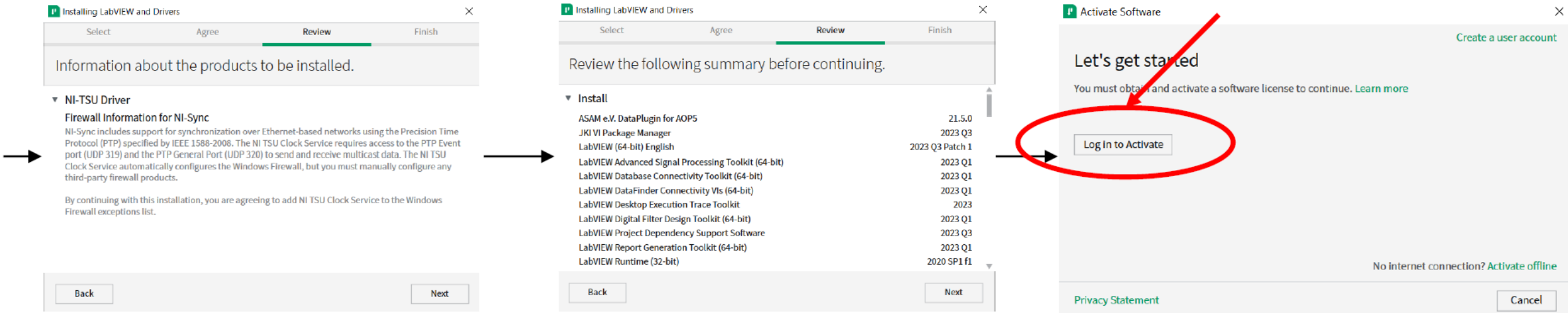
Installazione



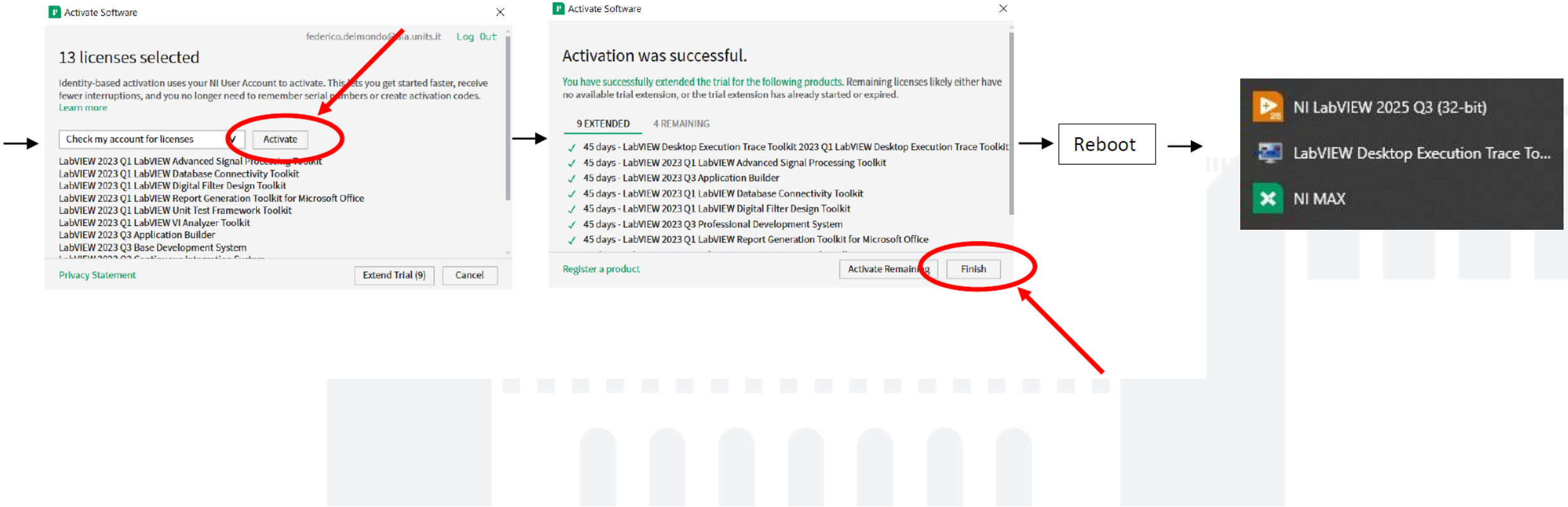
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UNIVERSITÀ
DEGLI STUDI
DI TRIESTE



dipartimento
di ingegneria
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Ronelly De Souza

ronellyjose.desouza@dia.units.it

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