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Кафедра інформаційних систем та технологій

Лабораторна робота №5
з дисципліни
Сучасні методи обробки масивів даних

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1 КОД ЗАСТОСУНКУ

```
public class Lab5Streams : IStreamTopologyBuilder
{
    private const string InputTopic = "int.k-connect.csv.plastic-
pollution";

    private static JsonSerializerSettings GetJsonSerializerSettings()
    {
        return new JsonSerializerSettings
        {
            Converters = { new NaIntConverter() },
            ContractResolver = new DefaultContractResolver
            {
                NamingStrategy = new SnakeCaseNamingStrategy(),
            }
        };
    }

    public StreamBuilder BuildTopology(StreamBuilder streamBuilder)
    {
        JsonConvert.DefaultSettings = GetJsonSerializerSettings;

        var records = streamBuilder.Stream(InputTopic, new
StringSerDes(), new JsonSerDes<PlasticPollutionInfo>())
            .Filter((_, v, _) => v is not null);

        BuildVolunteersCountTopology(records);
        BuildUkraineTotalCountTopology(records);

        return streamBuilder;
    }

    private static void BuildVolunteersCountTopology(IKStream<string,
PlasticPollutionInfo> records)
    {
        const int minEventsThreshold = 10;
        var volunteersCountStream = records
            .Filter((_, v, _) => v.NumEvents < minEventsThreshold)
            .Map<string, int>((_, v, _) =>
KeyValuePair.Create("passed", v.Volunteers))
            .GroupByKey<StringSerDes, Int32SerDes>()

.WindowedBy(TumblingWindowOptions.Of(TimeSpan.FromSeconds(10)))
            .Aggregate<int, Int32SerDes>(
                () => 0,
                (_, v, agg) => agg + v
            )
```

```
            .ToStream();

        volunteersCountStream.Print(Printed<Windowed<string>,
int>.ToOut());
    }

    private static void
BuildUkraineTotalCountTopology(IKStream<string, PlasticPollutionInfo>
records)
    {
        const string ukraineEventsKey = "Ukraine";
        var totalCollectedInUkraine = records.MapValues<long>((_, v,
_) => v.NumEvents)
            .Filter((k, _, _) => k is ukraineEventsKey)
            .GroupByKey()

.WindowedBy(TumblingWindowOptions.Of(TimeSpan.FromSeconds(10)))
            .Aggregate<long, Int64SerDes>(
                () => 0,
                (_, v, agg) => agg + v
            )
            .ToStream();

        totalCollectedInUkraine.Print(Printed<Windowed<string>,
long>.ToOut());
    }
}
```

1.2 Код застосунку для збору метрики затримки споживача

```
public class Lab5ConsumerLagStreams : IStreamTopologyBuilder
{
    private const string InputTopic =
"int.streaming.plastic.pollution.consumer-lag";

    private static JsonSerializerSettings GetJsonSerializerSettings()
    {
        return new JsonSerializerSettings
        {
            Converters = { new NaIntConverter() },
            ContractResolver = new DefaultContractResolver
            {
                NamingStrategy = new SnakeCaseNamingStrategy(),
            }
        };
    }

    public StreamBuilder BuildTopology(StreamBuilder streamBuilder)
    {
```

```
        JsonConvert.DefaultSettings = GetJsonSerializerSettings;

        var records = streamBuilder.Stream(InputTopic, new
StringSerDes(), new JsonSerDes<ConsumerLagDescriptor>())
            .Filter((_, v, _) => v is not null)
            .GroupByKey()
            .WindowedBy(Of(TimeSpan.FromSeconds(10)))
            .Aggregate<ConsumerSumCountDescriptor,
ConsumerSumCountDescriptorSerDes>(
                () => new ConsumerSumCountDescriptor(),
                (_, v, agg) => new ConsumerSumCountDescriptor(
                    v.ConsumerGroup + v.Topic,
                    agg.Sum + v.Lag,
                    agg.Count + 1
                )
            )
            .MapValues((r, _) => new
ConsumerAverageLagDescriptor(r.Consumer, Math.Floor(r.Sum * 1.0 /
r.Count)))
            .Suppress(
                SuppressedBuilder.UntilWindowClose<Windowed<string>,
ConsumerAverageLagDescriptor>(
                    TimeSpan.FromMinutes(1),
                    StrictBufferConfig.Unbounded()
                )
                .WithValueSerdes(new
ConsumerAverageLagDescriptorSerDes())
            )
            .ToStream();

        records.To(
            "consumer-average-lag",
            new TimeWindowedSerDes<string>(new StringSerDes(),
10_000),
            new JsonSerDes<ConsumerAverageLagDescriptor>()
        );

        return streamBuilder;
    }
}

internal sealed record ConsumerSumCountDescriptor(string Consumer =
"", long Sum = 0, int Count = 0);

internal sealed record ConsumerAverageLagDescriptor(string Consumer,
double Lag);

internal sealed record ConsumerLagDescriptor(string ConsumerGroup,
string Topic, long Lag);
```

```
internal sealed class ConsumerSumCountDescriptorSerDes :
AbstractSerDes<ConsumerSumCountDescriptor>
{
    public override byte[] Serialize(ConsumerSumCountDescriptor data,
SerializationContext context)
    {
        var json = JsonConvert.SerializeObject(data);
        return System.Text.Encoding.UTF8.GetBytes(json);
    }

    public override ConsumerSumCountDescriptor Deserialize(byte[]
data, SerializationContext context)
    {
        return
JsonConvert.DeserializeObject<ConsumerSumCountDescriptor>(System.Text
.Encoding.UTF8.GetString(data))!;
    }
}

internal sealed class ConsumerAverageLagDescriptorSerDes :
AbstractSerDes<ConsumerAverageLagDescriptor>
{
    public override byte[] Serialize(ConsumerAverageLagDescriptor
data, SerializationContext context)
    {
        var json = JsonConvert.SerializeObject(data);
        return System.Text.Encoding.UTF8.GetBytes(json);
    }

    public override ConsumerAverageLagDescriptor Deserialize(byte[]
data, SerializationContext context)
    {
        return
JsonConvert.DeserializeObject<ConsumerAverageLagDescriptor>(System.Te
xt.Encoding.UTF8.GetString(data))!;
    }
}
```

Код на стороні споживача, для передачі метрики у кафку

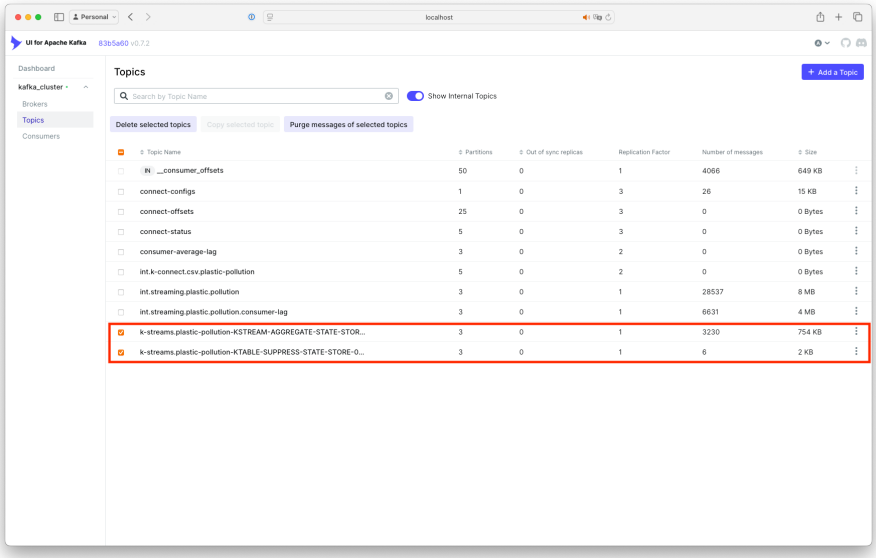
```
var cts = new CancellationTokenSource();
var lagChannel = Channel.CreateUnbounded<ConsumerLagDescriptor>();
var lagExporter = new ConsumerLagExporter(lagChannel.Reader);
_ = Task.Run(() => lagExporter.StartAsync(cts.Token));

internal sealed class ConsumerLagExporter
{
    private readonly ChannelReader<ConsumerLagDescriptor>
```

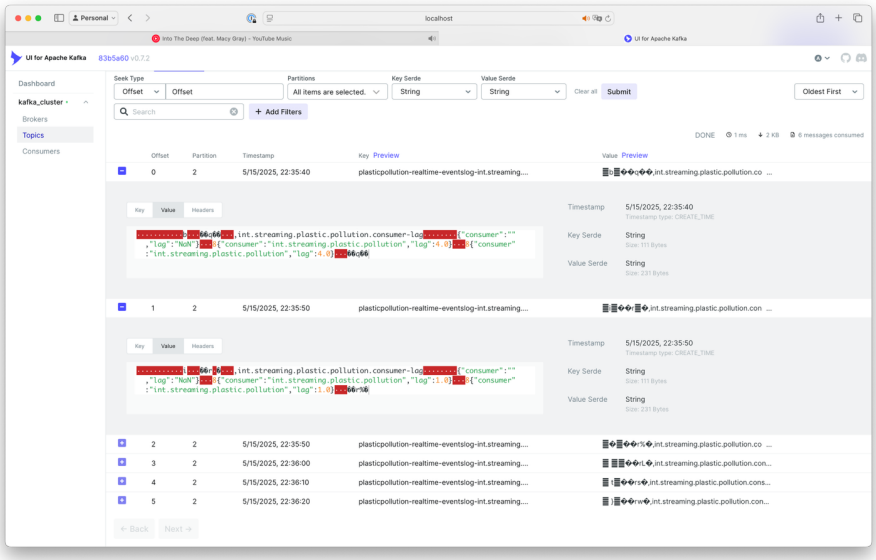
```
_channelReader;
    private readonly IProducer<string, string> _producer;

    private const int ExportIntervalMs = 100;
    private const string ExportTopic =
"int.streaming.plastic.pollution.consumer-lag";

    public ConsumerLagExporter(ChannelReader<ConsumerLagDescriptor>
channelReader)
    {
        _channelReader = channelReader;
        var producerConfig= new ProducerConfig
        {
            BootstrapServers =
"PLAINTEXT://localhost:19092,PLAINTEXT://localhost:29092,PLAINTEXT://
localhost:39092",
            Acks = Acks.Leader
        };

        _producer = new ProducerBuilder<string,
string>(producerConfig).Build();
    }

    public async Task StartAsync(CancellationToken ct)
    {
        while (await _channelReader.WaitToReadAsync(ct))
        {
            while (_channelReader.TryRead(out var lagDescriptor))
            {
                try
                {
                    var message = new Message<string, string>
                    {
                        Key =
$"{lagDescriptor.ConsumerGroup.ToLowerInvariant()}-
{lagDescriptor.Topic}",
                        Value =
JsonSerializer.Serialize(lagDescriptor)
                    };

                    await _producer.ProduceAsync(ExportTopic,
message, ct);
                }
                catch (ProduceException<string, int> e)
                {
                    Console.WriteLine($"❌ Kafka Produce Error:
{e.Error.Reason}");
                }
```

```
                Console.WriteLine($"✅ Exported Lag:
{lagDescriptor}");
                await
Task.Delay(TimeSpan.FromMilliseconds(ExportIntervalMs), ct);
                Thread.Yield();
            }
        }
    }
}


internal sealed class KafkaConsumer
{
    ...

    public void Consume()
    {
        ...

        try
        {
            while (true)
            {
                try
                {
                    // ... same as before ...

                    ExportConsumerLag(consumeResult);
                }
                catch (ConsumeException e)
                {
                    Console.WriteLine($"❌ Kafka Consume Error:
{e.Error.Reason}");
                }
            }
        }
        ...
    }

    private void ExportConsumerLag(ConsumeResult<string, string>
consumeResult)
    {
        var watermarkOffsets =
_consumer.GetWatermarkOffsets(consumeResult.TopicPartition);
        var committedOffset = consumeResult.Offset;

        var lag = watermarkOffsets.High - committedOffset;

        var lagDescriptor = new ConsumerLagDescriptor(
```

```
            _consumerGroup,
            consumeResult.Topic,
            lag
        );

        _lagChannelWriter.TryWrite(lagDescriptor);
    }
}
```

2 СКРІНШОТИ З РЕЗУЛЬТАТАМИ РОБОТИ





3 ВИСНОВКИ

У цій роботі було використано Kafka Streams для обробки вхідного потоку даних та їх агрегації за допомогою використання операцій зі збереженням стану.